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Co-operative Research in the United States.

A RECENTLY issued Circular of the Bureau of Standards (No. 296), gives a full account of an interesting scheme of co-operative research which has been developed at the National Bureau. That institution, like our own National Physical Laboratory, has experienced the effect of the demand for trained research workers emanating from manufacturing industries, in the shape of a constant drain upon the personnel of the establishment. That the unquestionable advantages of research are thus gaining appreciation in the commercial world is very gratifying, and there can be no doubt that our industries are benefiting materially by the enlistment of research workers of proved ability and resourcefulness in their service, whilst the financial position of those workers is undoubtedly improved by the change of employer; but the loss of valued members of the staff, who cannot be speedily replaced, no less certainly constitutes a serious problem for the management of the laboratories.

The plan adopted by the Bureau of Standards is admirably conceived to benefit all parties, by providing a steady stream of trained research workers, familiar with the methods and resources of the Bureau, and capable of supplying the needs both of the Bureau and of industry. The fact that the scheme has recently "grown notably both in magnitude and variety of fields" indicates that it has proved its utility, and there appears to be no good reason why it should not be equally successful in this country, where the extension of research is so greatly needed.

Simultaneously with the foundation of the Bureau of Standards in 1901, the use of the scientific and technical research facilities of the Government by investigators and students was sanctioned by Congress, and there are to-day 61 research associates in the Bureau, maintained by 36 organisations. The plan is intended to permit qualified workers to utilise the Bureau's facilities and staff in conducting researches of mutual interest; to provide for training and experience in research in an institution specially concerned with that class of work, to promote close co-operation between the industries and the Bureau, to encourage the appli-

cation of science to industry, and to lend the prestige of the Government to the results of research. The "research associate" is appointed by the Director of the Bureau, but is employed by an industrial association or group, which desires the solution of some outstanding problem; he is usually a graduate, and to all intents and purposes becomes for the time a member of the staff. Each proposed research is approved by the Director, and monthly progress reports are made to the supporting association through him; the results are made available to the industry concerned by publication, but, apparently, may be treated as confidential, at the discretion of the Director. Inventions arising out of the research must be placed freely at the disposal of the public. Needless to say, the splendid resources of the Bureau—in respect of equipment, staff, and literature—together with those of the other Government institutions in Washington, immensely facilitate the specialised work of the researcher, whilst exceptional opportunities for private study are provided.

The circular to which we have referred gives examples of enormous savings effected by the work of the Bureau, such as 20 millions a year from motor-fuel researches; incidental economies are also realised, such as an estimated saving of £100,000 a year in insurance premiums by owners of lifts, the outcome of the Bureau's researches on interlocks. Examples of the work done by research associates are cited; for instance, the American Electric Railways Association instituted a research into the cause of breakage of welded rail joints, which were apt to fail in a year or two, whilst the rails lasted 15 or 20 years; it was found that butt-welded joints withstood many times as many impacts as seam-welded joints. "It is not unusual that a research pays dividends a hundred times its cost". . . if only our political and industrial leaders could be brought to a full appreciation of that fact! Amongst the many associations maintaining research associates at the Bureau is the American Society of Mechanical Engineers, which has two experts engaged in determining with precision the numerical constants and the properties of steam, as a basis for its more effective use.

From the particulars given in the Circular we are led to the conclusion that the system described is well worth the consideration of the Department of Scientific and Industrial Research, in conjunction with the Director of the National Physical Laboratory and the Research Associations assisted by the Department. It does not appear to compete with the work of the Universities, as the research associates employed are not novices, but graduates qualified to initiate and conduct research; the scheme, therefore, provides remunerative employment for university-trained men and a convenient avenue of access for them to the fields of applied science in industry.

It is interesting to note, in the Report of the Executive Committee of the National Physical Laboratory which has recently been issued, that the Laboratory does its best to place the knowledge which it has acquired at the disposal of industrial firms, whose representatives frequently visit the N.P.L. in search of information; but the numerous claims on the time of the staff render it difficult to provide adequately for this service. Many visitors from dominion, colonial, and foreign institutions are received at the Laboratory, and in some cases the technical officers of oversea Government departments are allowed to work for a period at the Laboratory in order to acquire familiarity with the methods employed in particular branches of work. Thus the Laboratory has already gone some distance along the path followed by the Bureau of Standards, and we trust that it will be found possible for it to go the whole way.

The Balfour Committee Still Sitting.

It were base ingratitude not to express sympathy with the members of the Balfour Committee on Industry and Trade in the enormous mass of information that it is falling to their lot to listen to and inwardly digest in the hope that they may ultimately guide the nation of the future to right conclusions. We are not surprised that members fall out by the way, though it says much for the public spirit of business men and women to find others ready to step into their places and carry on the good work.

Some of the subjects lately brought forward seem to suggest that the taking of evidence is nearing its end —or ought to be. Not that we desire to under-estimate the importance of these recent subjects, though they do seem to be of the "general" rather than the special class. For example, the Trade Exhibition Organisers' Association is reported as giving evidence regarding the inimical effects of the British Industries Fair upon the interests of its members. We are afraid that its efforts to excite sympathy for private exhibition organisers because of the increased patronage which our trades are giving to the Fair will meet with little success. So far as the electrical industry is concerned, it has shown plainly for many years that it can look after itself in respect of exhibitions. Indeed, we recall the early discussions out of which the present electrical exhibition policy developed; the industry then saw, as it sees now, that it was quite capable of running its own affairs and keeping the profits within the family circle. In co-operation with the Government it can run a thoroughly businesslike electrical section at the British Industries Fair. It is claimed that private organisers can bring to their exhibitions more overseas buyers than have so far been lured to the British Industries Fair. Here we should require to examine the evidence of both sides, but whatever has been in the past we hope that the 1927 Fair at Birmingham will be well patronised by overseas visitors because specialised action is to be taken in time to invite them.

Another point brought before the Balfour Committee is the position of the commercial traveller. The evidence did not relate to the electrical trade, but no doubt it interests this indispensable section of staffs connected with our trade. Exactly where the grievances of commercial travellers fit into the Balfour mosaic may not be immediately obvious, yet the fact that commercial travellers are making lower average earnings now than before the war, owing to the cost of living, is a tendency to be noted, though it may be partly due to bad trade and partly to the class of occupation becoming less attractive to the most suitable men. The evidence was advanced by the National Union of Commercial Travellers, and it included reference to the fact that employers in some trades were pledged not to take into their service any traveller who had left a competing firm. We have heard, on the other hand, of firms which have done their utmost to entice away other firms' travellers for the sake of their connections, afterwards dispensing with their services at the earliest convenient opportunity.

Yet a further point. Travellers sometimes in a moment of eagerness or of desperation, sign an unfair and harsh agreement in order to secure an appointment, and they regret it afterwards. We have often touched upon this point, but commercial traveller readers will know how, acting alone, they are likely to fall into such traps. Their Association asks the Balfour Committee to say that such agreements should by legislation be declared invalid.

All these are very interesting points, and they will find a place in the complete, many-volumed work of the Balfour investigators, but it requires all the optimism at our command, and more, to believe that we shall live to see much legislation as the direct outcome of its work.

Flaming June.

The change to "Summer-time" came upon us to the accompaniment of a hailstorm in London, but to compensate somewhat the post-bag brought us particulars of further events that are to be expected when June arrives. The programme of the Conference of the Electrical Contractors' Association and allied organisations which is to be held in June at Brighton completes, we hope, the list of engagements for that month. In the Electrical Review for April 2nd (p. 545) we published the advance

programmes for the I.E.E. Summer meeting, which takes place at Newcastle-on-Tyne from June 7th to 12th, and for the I.M.E.A. Convention at Glasgow which opens on the following Monday (June 14th) and continues until the following Saturday. Very considerately the organisers of the Electrical Contractors' Convention have allowed the technical Press representatives and any other electrical gentlemen who may desire, or be compelled, to be present at all three engagements, a long week-end respite, for Wednesday (June 23rd) will be occupied with preliminaries, the really serious work of the first annual E.C.A. Conference only beginning on Thursday and continuing throughout Friday. Altogether there will be between two and three weeks full of professional and business interest, interspersed with a round of social events which will make June a record month in 1926. But how much trouble might have been spared by all pulling together in the organisation of one big convention, and how much more effective would have been its electrical advertising effect upon the public mind in this year of Parliamentary and Press discussion of electricity supply!

The Optical Convention.

THE Optical Convention is now over, and no doubt on the whole it has answered the hopes of its supporters. The display of apparatus was imposing, and the grafting on to the serious part of the programme of the series of "scientific marvels" and "optical illusions" was an ingenious step. Certainly, even allowing for the advantage of securing the Prime Minister to open the Convention, the publicity arrangements appear to have been well managed. It is rarely that a scientific exhibition gains so much attention in the daily Press. The electrical industry might with advantage study the methods employed—for electricity could surely present an equally imposing record of work accomplished and future possibilities. The series of papers read at the Convention was a comprehensive one and served to show the many-sided aspects of optics. We were glad to see included in the programme a paper by Mr. L. Gaster, emphasising the close relation between optics and illuminating engineering. Certainly a very large part of the work illustrated and described is of interest to all concerned with lighting problems. It is a misfortune that modern science is divided into such watertight compartments; many optical inventions for a specific purpose would find other applications if they were more widely known. The Convention, therefore, has done something towards bringing scientists together. Has it been equally successful in impressing the public with the value of optics? One wonders. We suspect that a large proportion of the non-technical public visited the entertainments but did not make much progress in the exhibition proper. We are inclined to suggest that on another occasion more attempt might be made to explain how the illusions were worked; by this means the public would be instructed besides being entertained.

Electric Cranes in Foundries.

IN a foundry in the North of England an overhead carrying system was installed recently, and it is estimated that a saving of nearly 30 per cent. of the handling costs has been effected. In many foundries, especially of the jobbing kind, hand-operated cranes are still used, but in repetition foundries power cranes and runways have been chiefly used for a number of years. It is rather surprising that automatic electric runway systems, or telphers, have not come into more general use for conveying materials about foundries. There is certainly great scope for them in repetition foundries in delivering castings from the moulding shop to the dressing shop, and thence to the forwarding department—where there is a special forwarding department. The telpher, operated from the floor by a switch, is not a novelty, and it requires little skill to operate it. Perhaps it is because its excellent qualities have not been sufficiently made known that it has not come into more general use.

In America, electrical lifting and conveying plant is common in both ferrous and non-ferrous foundries and, in a certain technical journal, an instance was given recently of a foundry where a daily production of over 22,000 pounds of castings was maintained with only one moulding machine; two electric hoists, of three tons capacity each, handle all materials and do their work with an efficiency that makes this high production possible. In turning out this tonnage nearly 330 tons of moulding boxes, moulds, ladles, castings, &c., must be lifted, moved, and lowered. The simple electrical equipment takes the place of a complicated system of jib cranes, wheel-barrows, and other manual labour.

There are other advantages of electric cranes besides reducing operating costs, because, as already indicated, they have a big bearing on production. In a repetition foundry the work is kept moving in an unbroken flow, and the most efficient use is made of floor space. It is sometimes contended that hand-operated cranes are all that is required in small jobbing foundries, but, in the smaller non-ferrous foundry, modern equipment is well worth while, and in the large foundry which specialises in heavy machine-tool and engine castings a very considerable saving in labour charges can be effected.

Copper.

THE market for this metal has been languishing for a considerable time now, and values touched a very low level. Indeed, the standard market declined to about the lowest point reached since the war. The remarkable feature is that this has all occurred in face of practically a record consumption. Of course, it has to be remembered that production is also at a record rate, and it is therefore necessary for consumption to keep at top notch if the situation is not to deteriorate statistically and values to be affected adversely. The principal cause of the unsatisfactory appearance of the market for some time past has, of course, been the poor economic and industrial position in Germany, where consumption fell off to a marked degree. This was a matter of considerable importance to the copper industry, as that country is normally such an important outlet for American copper. Meanwhile, consumption in the United States has been very well maintained, and although there are some doubts as to whether it is keeping up to its highest level, it certainly does not appear to have fallen away much just yet, but this in itself was insufficient to support the market in face of the diminution in Europe's takings. Latterly, however, the market has attracted more interest, and has assumed a rather better appearance. One of the reasons for this was the report that the stocks of refined copper in America had decreased during March to the extent of fully 11,000 tons, bringing the total stocks of refined metal there down to about 75,000 tons. This is no doubt all to the good, but there were other features in last month's statistics which were not quite so satisfactory, one being that refined output had increased and another that the deliveries showed such a large expansion compared with the previous month as to suggest that it was due to some accidental circumstance. However, even leaving these figures aside, the position does seem to have a slightly better aspect for the reason that there are certain indications which suggest that conditions in Germany have turned the corner, and although this has not yet translated itself into any very large buying of copper, a certain amount of business has already been done in connection with electrical schemes there, and it seems reasonable to believe that more is likely to follow. The importance of the electrical industry to the copper trade can be realised when it is mentioned that well over 60 per cent. of the American deliveries of refined copper are in the form of wire bars, the shape used for drawing into wire. In this country, of course, the outlook is somewhat obscured by the various clouds hanging over the labour position, but a factor which should not be lost sight of is that copper is at a very reasonable price.

The Manufacture of Radio Valves.

Some Impressions of a Visit to the Mullard Co.'s Thermionic Valve Factory.

One of the most noteworthy, and it may be also far-reaching, steps ever taken in the history of the British "wireless" industry was accomplished recently by the agreement for collaboration of the Mullard Radio Valve Co., Ltd., with Philips Glowlamp Works, Ltd., of Eindhoven, Holland.

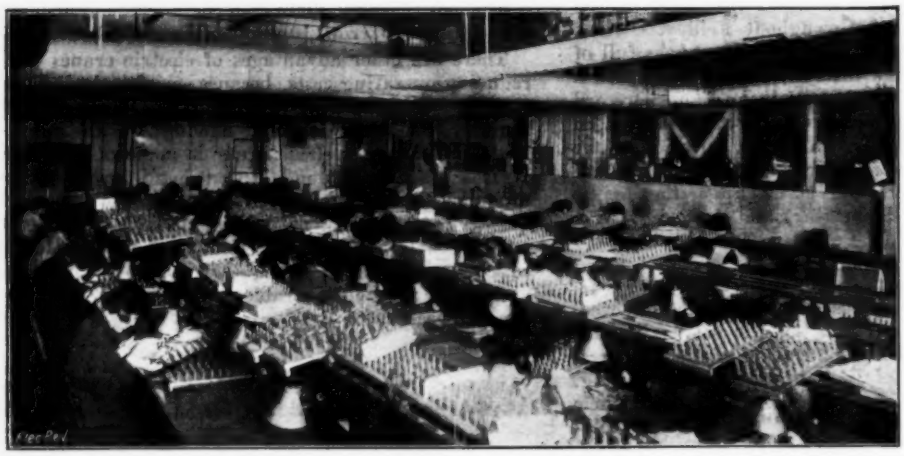


Fig. 1.—A View of an Assembling Unit.

Prior to this arrangement, Messrs. Philips were the largest exporters of radio valves to this country, but since the conclusion of the above-mentioned agreement they have ceased to send their valves here. The cessation of this supply implies increased British production to meet the demand of the home market, thus creating more employment for British labour. Further, the arrangement means that all Mullard valves will henceforth be manufactured in Great Britain under the combined valuable patents of the two firms concerned, for it has conferred upon the Mullard Co. the right to the exclusive use of all Philips patents and improved processes relating to the specialised manufacture of thermionic valves. Messrs. Philips have corresponding similar rights under the Mullard patents with respect to the Continental markets, and a separate concern, known as the Mullard Wireless Service Co., Ltd., has lately been formed to take over the sale of the products manufactured by the Mullard Radio Valve Co., Ltd. Both the British Companies are under the able managing directorship of Mr. S. R. Mullard, M.B.E., M.I.E.E., who is also chairman of the Service Co.

Established in a small way at Hammersmith, the Company's manufacturing organisation has grown steadily until to-day its factory in South-West London, at Balham, is claimed to be one of the largest in Europe devoted solely to the production of radio valves. Considerable improvements have recently been carried out, and present indications are that an extension of the premises cannot be long deferred. The organisation affords employment for some 400 people at present; the factory is equipped on modern lines and the plant and machinery is of up-to-date design, much of the latter being of the automatic or semi-automatic pattern; electricity is used extensively for lighting, power, heating, and testing purposes, and the switchgear and mains have recently been modernised to deal with a maximum load current of 2,500 amperes at 200 volts, while the overhead air ducts visible in the accompanying illustrations show that the efficient ventilation of the premises has received

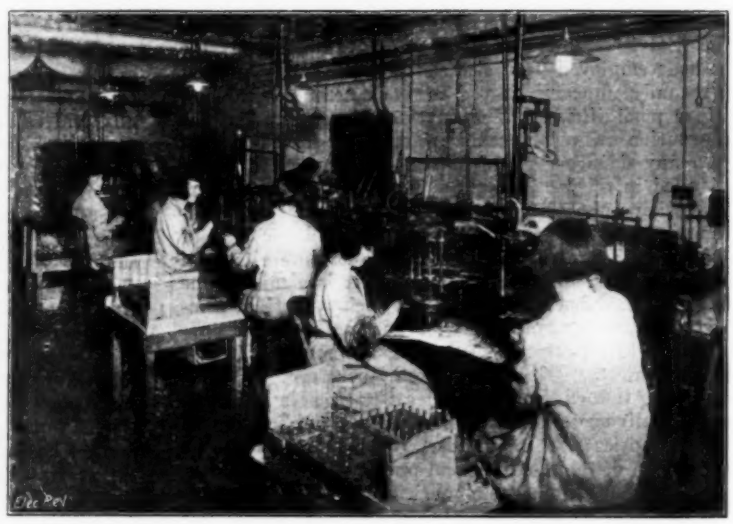


Fig. 2.—A Sealing-in Unit.

Fig. 3.—High-power Silica Valve Bay.

attention. The factory is so organised that the various manufacturing operations which the component parts pass through follow one another consecutively in order to reduce transportation to the minimum. Commencing in the Components Departments, where the initial processes in the manufacture of connecting wires, supports, and electrodes are carried out, and the glass tubing necessary for making the "feet" is cut into the desired lengths, the parts pass to the Assembling Department (a section of which is illustrated in fig. 1), where the electrodes are mounted and prepared for sealing them into the glass bulbs, which operation is performed by machines such as those shown in fig. 2. The valves are then sent to the pump benches (fig. 4), where they are exhausted and sealed off, at which stage they are ready to undergo preliminary tests. It is understood that at every stage of their manufacture the valves are subjected to close inspection and metal parts gauged; such repeated precautions may be considered expensive, but it is economical to check a faulty article at an early stage in its production, and thus afford a chance of rectification rather than reject it on completion, which would involve wastage of material.

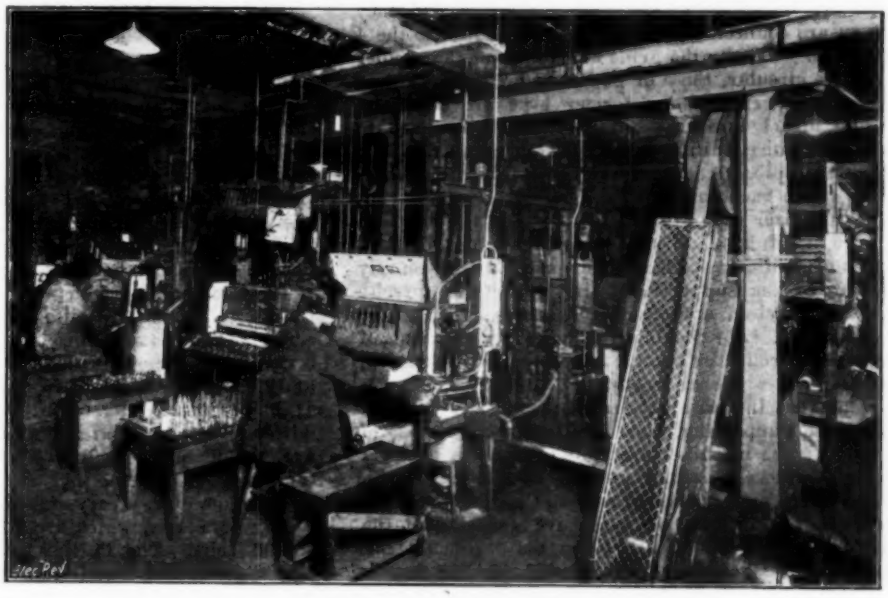


Fig. 4.—A Portion of the Pump Room.

Fig. 5.—Final Test and Inspection Department.

Following the "getter" process (when necessary), heat treatment, and ageing, the valves are "capped" (fitted with bases) and then finally tested (fig. 5); the glass bulbs are next acid-etched with distinctive marks and painted with coloured rings according to type, cleaned externally, and then packed ready for dispatch. In this connection it is to be regretted that the various manufacturers distinguish valves of similar rating differently, for it would be much more convenient and satisfactory to the user if all makes of similar characteristics were designated in a uniform manner. Electric welding machines are employed freely in making the

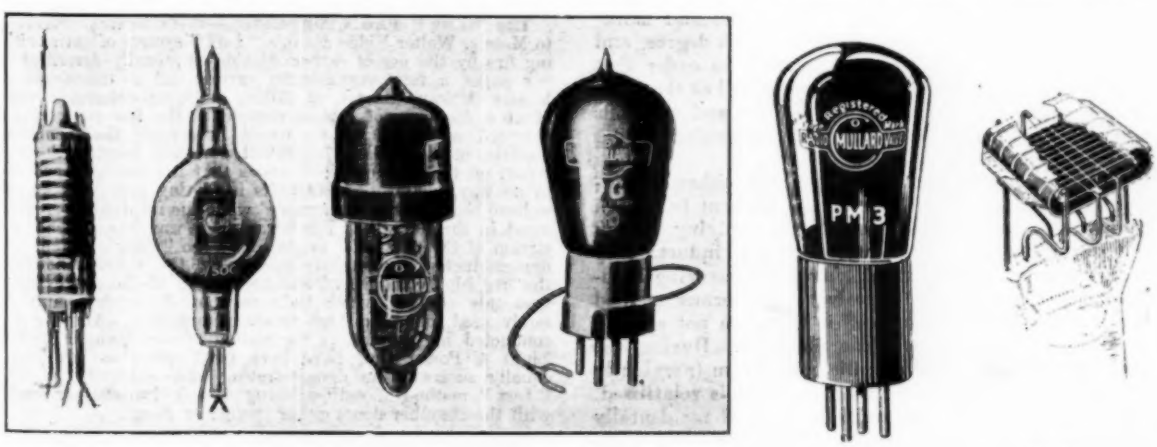


Fig. 6. Fig. 7. Fig 8. Fig 9. Fig 10. Fig. 11.

A Selection of the Types of Thermionic Valve made by the Mullard Company.

electrodes, which are carried on stiff nickel supports that are joined to fine platinum (or a substitute which enables a good airtight seal to be made) wires, which are embedded in the glass "pinch," and they in turn are connected to copper wires soldered to the 4 valve pins. Usually the grids and plates of the smaller valves are circular, those of power valves being oval or rectangular: grids of the former type are made by winding nickel wire over a metal former threaded to the correct pitch, suitable lengths being cut and placed in jigs with pieces of stiff nickel wire laid along them and to which each coil is welded at the points of contact; the latter type are wound direct on the supporting wire, which has been previously bent to the required shape and similarly welded. Thus each coil is securely attached to the supporting wire, and the precise diameter, spacing, and number of turns are fixed by the setting of the machines. Anodes are cut out of sheet nickel, rolled or stamped to the requisite shapes, and their edges welded together.

A somewhat intricate pattern of machine is used for sealing the supporting wires in the glass "feet" of the valves; the machines are similar to those used for making the corresponding portion of electric lamps, the operations being timed exactly so that the glasswork is rotated and heated by successive gas jets to the right degree at each stage. When the "pinch" has been made, the glass part is annealed and the foot is placed in a jig, which cuts and bends the supporting wires to the requisite lengths and shapes. Next, the filament (after undergoing a cleansing process) is inserted and welded to its supports, as are also the grid and anode, the machines used for assembling the electrodes being arranged to automatically locate and fix the elements in position. The filament of the 60-milliampere class of valve is so fine as to be only just visible to the naked eye; to enable it to be handled with facility the wire has attached to it small nickel clips which are so spaced as to give filaments of the correct length. The wire is laid in position and one clip welded to each filament support, the surplus being cut off.

Shaped bulbs purchased from the glass manufacturer are each fitted with a small glass tube, which acts as the exhaust pipe; in the case of the "pipless" pattern, exhaustion takes place through the "foot" of the valve. After internal cleansing it is placed over a "foot" carrying the electrodes, which is mounted in a machine and rotated through successive gas jets so that the glass base gradually softens, and finally the bulb and "foot" unite. On cooling, a tap removes the surplus glass, and after being annealed, the bulb is ready for the pumps. It is interesting to note that the liquid air needed for the pumps is produced on the premises.

Exhaustion is one of the most critical and costly operations of the whole manufacturing process. A "dull emitter" can only be satisfactory if it is considerably "harder" than a bright valve; that is, strict precautions are necessary to produce and maintain a good vacuum by exhaustion to a high degree, and during evacuation the valve is heated in order that occluded gases contained in the glass as well as the metal electrodes and their supports may be removed and thus minimise the harmful quantity that is liberated during the life of the valve.

The valve may be heated in two ways: either by electron bombardment (*i.e.*, raising the filament to a high temperature and at the same time applying a high voltage to the grid and plate), or the induction or eddy-current method (*i.e.*, placing a coil carrying high-frequency current over the valve); the former method involves filament wastage, and is therefore not applied to valves containing very fine filaments. During the heating a small piece of metallic magnesium (previously affixed to the anode during its formation) is volatilised, thus "getting" the last trace of gas and incidentally resulting in a silvery deposit inside the glass bulb. To enable a "dull" filament to emit electrons at its normal operating temperature, it has to be activated by heat treatment, which produces a chemical action between the thoria and tungsten of which it is composed. It is accordingly "flashed" at about 2,900 deg. K. for one minute, its temperature is then reduced to about 2,250 deg. K. for three or four minutes, and finally lowered to the normal working value of about 1,700 deg. K. The filament alone is heated (the grid and anode being inactive meanwhile), the voltage applied (approximately three times the normal) depending on the composition of the wire; the result is a diffusion of the thorium outwards, forming a coating on the surface of the filament, the free emission thereafter at low temperature being characteristic of thorium instead of tungsten. Either before or after the valves are completed by having their bases fitted, they are hung on "ageing" racks and run for a time under normal conditions before undergoing their final tests.

The Company's products are too numerous to mention individually: fig. 5 illustrates a part of the bay wherein high-power silica valves are made, and such a valve, capable of 10 kW continuous anode dissipation at 12,000 volts, is shown in fig. 6; its filament consumes 47 amps. at 28 volts. Fig. 7 indicates a glass transmitter of 300 watts at from 2,500 to 5,000 anode voltage, the filament needing 8 amps. at 18.5 volts; this type is assembled in such a way that the filament is easily renewable. Very similar in appearance are the rectifying valves, which are made to deliver d.c. up to 30,000 volts. The Philips-Mullard 30-kW valve is of the water-cooled metal-glass pattern. Two types of low-temperature thoriated-tungsten transmitters are made, the larger having an impedance of 4,500 ohms at 200 anode volts, and being suitable for an input of 20 watts.

Turning to receiving valves, fig. 8 shows an "ORA" type B, and a 4-electrode (or double-grid) valve is illustrated in fig. 9, which may be connected so as to neutralise the space charge and give good reception at anode voltages of from zero upwards; it may also be used to obtain dual amplification in the anode circuit by coupling the latter through a transformer back to the second grid. As an example of "dull emitters," the D.06 type is well known, but the latest pattern made by the Mullard Co. is the "PM" group, which is composed of the PM2, PM3, PM4, PM5, and PM6. They are all pipless (fig. 10), and the PM3 and PM4 possess an "N"-shaped filament (fig. 11), whilst the PM5 and PM6 have an "M" filament. The four valves take a filament current of only 0.1 amp. which can be supplied by dry cells. Other products are valve holders, fixed tubular condensers, the Holweck molecular pump, and carbonised cellulose resistances; it is claimed that the method of manufacturing wire-wound anode resistances enables the desired value to be attained with a 3 per cent. accuracy. In conclusion, it may be remarked that special classes of valves are produced for the Royal Air Force and the Admiralty.

The "Lux" Fire Extinguisher.—With further reference to Messrs. Walter Kidde & Co.'s "Lux" system of extinguishing fire by the use of carbon dioxide as recently described in our pages, a test was recently carried out at the works of Messrs. Brown, Boveri, of Milan, Italy, to determine what effect a discharge of carbon dioxide at the low temperature obtained with this system would have upon the insulating qualities of a standard 70,000-volt porcelain insulator. The report on the demonstration states that the insulator suffered in no way whatever; in fact, its insulating properties appear to have been materially improved when the insulator was enveloped in the CO_2 gas. Furthermore, it was shown that the stream of CO_2 "snow" produced by the "Lux" system is a non-conductor of electricity even when the distance between the live high-voltage lead and the nozzle of the gas cylinder was only 40 cm., which indicates that the system may be safely used to protect high-pressure apparatus. Another test conducted in America at the station of the United Electric Light & Power Co., New York City, seems to have been equally successful in demonstrating the efficiency of the "Lux" method of extinguishing fires in transformer vaults with the chamber doors either opened or closed.

Edinburgh Electrical Society.—A lecture was given on April 7th by Mr. G. Peers before the above Society on "The Electrical Equipment of a Battleship," when many interesting points, such as fighting efficiency, watertight installations, general lighting, and searchlights, were explained. Mr. J. G. Burchell, president of the Society, was in the chair.

Testing Porcelain Insulators under Artificial Rain.

By R. T. FLEMING, A.M.I.E.E.

(*Concluded from page* 615.)

A.I.E.E. Standards (No. 41, July, 1925) Insulator Test Specifications.

Clause 41-6.—Wet Flashover Voltage.—Wet flashover voltage is the voltage at which the air surrounding a clean, wet insulator or shell breaks down between electrodes with the formation of a sustained arc, the test being made as described under "Wet Flashover Test."

Clause 41-101.—(This clause is in particular reference to pin-type insulators, but the details referring to rain are common to all classes of insulators.)

Wet Flashover Test.—The testing arrangement shall be the same as in the dry flashover test, with the addition of equipment to provide a finely-divided and reasonably uniform spray at an angle of 45 deg. from the vertical and at a rate of 0.2 in. (5.07 mm.) per minute. The water shall have a resistance of from 6,000 to 8,000 ohms per inch cube (15,200 to 20,300 ohms per cm. cube), and shall be delivered to the spray nozzle at a pressure of not less than 35 and not more than 50 lb. per sq. inch (2.46 to 3.51 kg./sq. cm.) measured at the nozzle. The vertical and horizontal dimensions of the vertical area sprayed shall be measured in a plane through the vertical axis of the insulator, and shall be at least 1.75 times the corresponding overall projected dimensions of the insulator. The precipitation shall be determined by measurements taken, with the insulator removed, at the location of the top, centre, and bottom of the vertical axis of the insulator when in its test position.

The water shall be collected in a vessel having a top diameter of 6 inches. Individual measurements shall show a variation of not more than 25 per cent. from the mean of the three measurements.

V.D.E. Regulations. 12th Edition, 1925.

Instructions for the testing of suspension insulators valid from October 17th, 1922.* The spark-over voltage of strain and suspension chains shall be at least twice the supply voltage† when tested under rain falling vertically and at 45 deg. to the horizontal. The specific resistance of the rain should not exceed that of natural rainwater, about 50,000 ohms per cm. cube‡, and the rate of fall should be 3 mm. per min. The test must be carried out as far as possible under practical conditions as regards the position and the suspension of the insulators. The duration of the test shall be 5 min.

For apparatus to be used in the open air, the test voltage should be at least twice the nominal voltage, for 5 min. with the rain falling at the rate of 5 mm. per min. at an angle of 45 deg. C.

L'Union des Syndicats de l'Electricité, December, 1921.

A. Porcelain Insulators. Clause 12.—*Electrical Tests Under Rain.*—Artificial rain shall be produced having a precipitation of 5 mm. per minute. The water shall be taken from convenient mains and shall be at a temperature of 15 deg. C.; the jet shall be directed at 45 deg. to the axis of the insulator as set up in service. The voltage shall be gradually raised until sparkover takes place; this value should not be less than 90 per cent. of that stated by the manufacturer.

The preceding extracts of various testing specifications indicate the points wherein there is variation, and show the necessity of having at present a flexible equipment which is capable of adhering to any limits which may be laid down.

A *résumé* is given in the following table:—

TABLE II.

Comparison of Several National Specifications.

Nationality.	Authority.	Temp.	Precipitation.	Angle of precipitation.	Water resistivity.
British	B.E.S.A.	15°C.	1" in 5 mins. (0.2"/min.)	45°	Not greater than 20,000 ohms/cm.cube.
American	A.I.E.E.	—	0.2"/min.	45°	From 15,200 to 20,300 ohms/cm.cube.
French	L'Union des Sydicats d'Electricite.	15°C.	5mm./min. (0.4"/min.)	45°	Not stated.
German	V.D.E.	—	3 mm./min. ((0.12"/min.)	45° and 90°	Not greater than 50,000 ohms/cm.cube.

Some Special Tests Carried Out in the M-V Laboratory.

THE VARIATION OF SPARKOVER WITH WATER RESISTIVITY.

The effect of the resistance of the water used in sparkover tests is very marked; this point is mentioned in a recent paper* wherein the author states that one firm is "obliged to reserve the right to deviate from the above figures (presumably quoted in catalogue) at least 10 per cent. up or down," due entirely to the fact that in different tests the water resistivity varies.

In view of the number of contrary results reported for wet sparkover, some tests were carried out on standard 10-in. disk cap-and-pin type insulators to note this effect. The insulators were arranged in a string and the water was adjusted to a certain resistivity at a precipitation of 1 in. in 5 minutes at an angle of 45 deg.; the wet sparkover was then measured. After each flash the length of the string was reduced by one unit and the operation repeated. The results are shown in Table III, and graphically in fig. 12, p. 652.

TABLE III.

No. of Units.	Sparkover in kilovolts. Water resistivity in ohms/cm. cube.		
	21,200	6,800	1,750
1	47	44	40
2	84	85	73
3	123	115	95
4	164	148	106
5	210	180	145
6	242	212	175
7	282	246	212
8	320	285	242
9	357	310	283
10	396	350	320

Very similar curves to the ones shown have been obtained by the Compagnie Générale d'Electro-Céramique.† The unifying effect on the voltage distribution under rain is worthy of note and can be seen to advantage in the following table, giving string efficiencies based on Peek's empirical formula‡:—

$$\text{String efficiency} = \frac{\text{S.O. on } n \text{ insulators.}}{n \times \text{S.O. on 1 insulator.}}$$

* Adopted at the annual meeting, 1922, published in the *E.T.Z.*, 1922, p. 134.

† If the standard for suspension insulators is adhered to, the words "supply voltage" are to be replaced by "nominal voltage."

‡ A specific conductivity of 20 corresponds to this value.

* "Developments in Porcelain Line Insulators," by J. L. Langton, read before the International Conference of Large Electric Systems. Paris, 1925.

† Essais à très haute tension à sec et sous pluie sur Chaines d'Isolateurs, p. 17.

‡ Peek, "Electrical Characteristics of the Suspension Insulator. *Proceedings*, A.I.E.E. May, 1912.

Table IV.

No. of Units.	S.O. Dry.	Efficiency.	S.O. Wet. Water, v1,3.0.	Efficiency.
1	80	1·0	47	1·0
2	145	0·855	84	0·89
3	195	0·813	123	0·87
4	245	0·768	164	0·87
5	290	0·726	210	0·89
6	340	0·707	242	0·86
7	380	0·679	282	0·86
8	420	0·657	320	0·85
9	460	0·639	357	0·845
10	495	0·62	396	0·84

It will be noted that in the case of a dry string there is a steady decline of string efficiency to 62 per cent. at the eighth insulator, whereas in the case of the wet string the figure becomes 89 per cent. at the second insulator, and shows only a very slight decrease throughout the whole string; this feature is noted in the cases of wet tests whatever the resistivity of the water may be, the actual value of course altering. In general, the lower the water resistivity the lower the constant value for string efficiency. As a result of a number of tests at varying resistivities, it has been attempted to plot a series of curves (fig. 13) showing the variation of the sparkover voltage of strings of insulators consisting of one up to *ten* insulators. The particular use of these curves is to enable one at a glance to estimate the wet sparkover voltage for a given set of conditions. The curves cover tests at a rainfall of 0.2 sq. in. per min. inclined at an angle of 45 deg. It is impossible to maintain that the curves are perfectly accurate; they should only be regarded as an approximate check. The following Table V shows the percentage decrease in sparkover value as a function of the water resistivity. A resistivity of 20,000 ohms/cm. cube is taken as a 100 per cent. basis, it being the most usual figure aimed at in English practice.

Table V.

No. of units.	Water resistance in ohms/cm. cube.						
	20,000 %	16,000 %	12,000 %	8,000 %	6,000 %	4,000 %	2,000 %
2	100	98·5	98	92	88	85	79
4	100	99	97.5	92	86	82.5	67
6	100	97.5	95	90	86	80	74
8	100	98.5	95	91	88	84	78
10	100	97·5	96	90	87	85	82

The tests indicate the necessity of specifying the water resistance when carrying out S.O. tests under rain, and the advisability of having equipment with which these measurements can be made quickly and accurately.

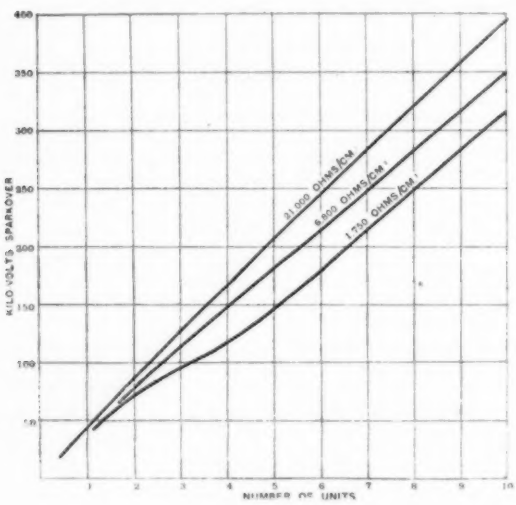


Fig. 12.

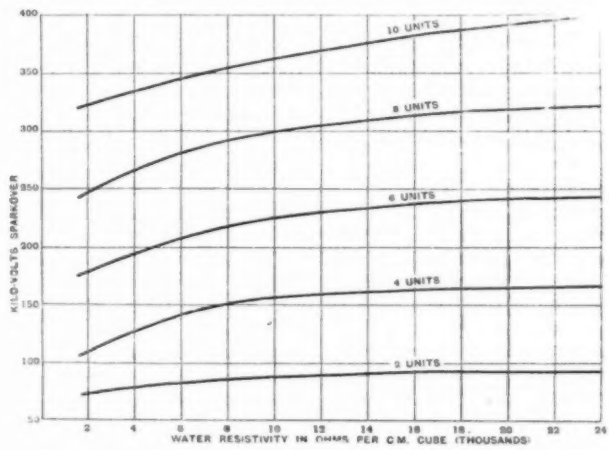


Fig. 13.

Figs. 12 and 13.—Variation of Sparkover with Water Resistivity and Number of Units.

Variation of Rate of Rainfall.

The tests on the insulators under varying water resistivity have shown the necessity of knowledge of factors when carrying out S.O. tests; to complete this a further number of values were obtained with alteration of the rate of precipitation, all other conditions being kept as standard as possible (*i.e.*, rain at 45 deg., resistivity 20,000 ohms per cm. cube).

Tests were carried out in a similar manner to those

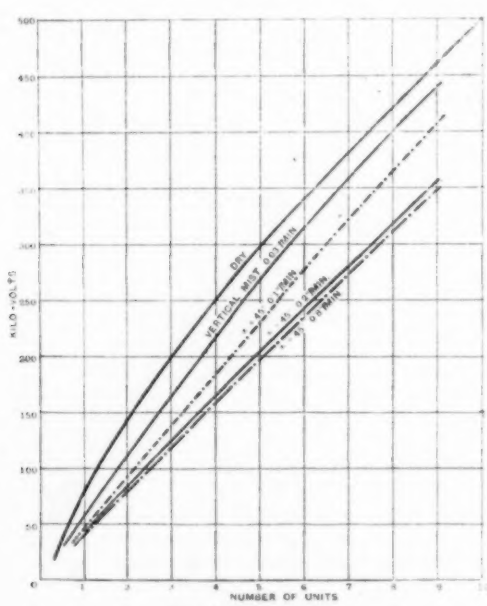


Fig. 14.

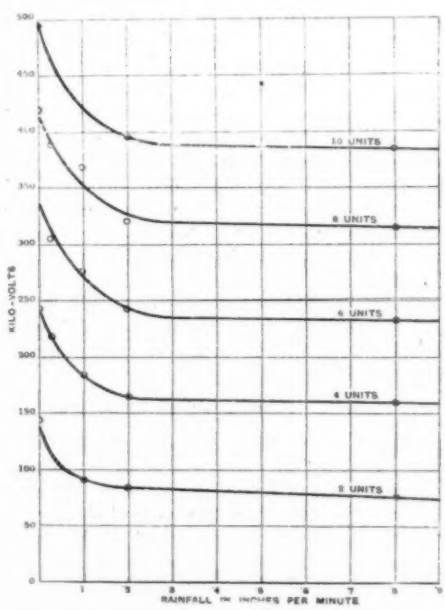


Fig. 15.

Figs. 14 and 15.—Variation of Sparkover with Rate of Rainfall.

previously reported; the results are given in Table VI and shown graphically in figs. 14 and 15.

TABLE VI.

No. of units.	Fine spray falling approx. vertically. 0.03"/min.	Rain falling at an angle of 45° to the vertical. Pressure 20 lb./sq.in.		
		0.1"/min.	0.2"/min.	0.9"/min.
1	·8	50	47	45
2	1·0	87	84	72
3	166	137	123	1·6
4	216	185	164	160
5	270	224	210	194
6	306	277	242	233
7	392	312	282	272
8	—	370	320	315
9	—	405	357	350
10	—	—	396	386

The results show quite a marked increase in S.O. values with precipitations lower than 0.2 in./min.; this is specially so in the case of a vertical mist where the values almost reach the magnitude of dry S.O. Any rainfall greater than 0.2 in./min. does not lower the values to any marked extent, as is shown in the comparatively small discrepancy between 0.2 in./min. and 0.8 in./min. The results indicate the necessity of obtaining at least 0.2 in./min. rainfall, which is the specified B.E.S.A. figure. The following Table VII shows the percentage decrease in sparkover value as a function of the rate of rain precipitation; the dry sparkover value is taken as 100 per cent.

TABLE VII.

No. of units.	Dry S.O.	Rate of rain precipitation at 45° in ins./min.			
		0.05"	0.1"	0.2"	0.8"
	%	%	%	%	%
2	100	·9	·2	57	52
4	,,	84	7·1	67	65
6	,,	87	80	72	68
8	,,	90	87	78	76
10	,,	9·	85	80	77

The author wishes to thank the Metropolitan-Vickers Electrical Co., Ltd., for permission to publish the tests; Messrs. Bullers, Ltd., Evershed & Vignoles, Ltd., and Drake & Fletcher, for leave to publish photographs of their products; and Mr. J. B. Mitford, of the M.V.E. Laboratory, for valuable assistance in the experimental work and general preparation.

[CORRECTION.—In the first part of this article (April 16th issue, page 614) under fig. 8, for "Dry, 355 kV" read "Dry, 422 kV," and for "Wet, 163 kV" read "Wet, 320 kV."

Under fig. 9, for "Dry, 370 kV" read "Dry, 355 kV," and for "Wet, 285 kV" read "Wet, 163 kV."

Under fig. 10 the values should also be reversed.]

The Future Price of Electricity.

An Estimate of the Limits Attainable.

By "INVICTUS."

WHILST we eagerly await details of the Government scheme for dealing with electricity supply in this country,* it is interesting to probe future possibilities as to price: to work from practical experience through the fluxing present to a future which, without being Utopian, is yet not inconceivable. What may we take to be the economic limit in the light of present experience, plus a little optimism?

According to the latest figures published by the Electricity Commissioners, the average cost of generation throughout the country for 1923 was 0.54d. per unit, and the average price paid by all consumers was 2.07d. per unit—roughly a ratio of 1 : 3, *viz.*, generation ¼d., other costs 1½d. A view of practical merit is that this ratio should be "fifty-fifty." Before examining this, it is well to consider the question of reliability of supply. High efficiency in generation, though important, is not so supreme a consideration for this country as reliability. If reliability is now given the degree of importance it demands, a period will be put to experiments in the siting of so-called super-stations. Even interconnection has its limits narrowed down by the two factors of price and reliability.

The present cost of a capital steam station may be put at £18-£20 per kilowatt of plant capacity. As a substitute for some spare plant, £20 per kilowatt of cable capacity represents equality. This is reached with a 5,000-kW cable 40 miles long, but its full duty would entail a loss of 10 per cent. in transmission. Such a cable might save the cost of a certain amount of stand-by plant, but yet there must be a margin at both ends to enable assistance to be given in emergencies. Also, such a cable might usefully give and receive energy along its route, and it is this consideration chiefly which favours comparatively short cable interconnectors for use in this country.

It may be said that the cost of an equivalent overhead line would be only half that of a cable. But is it not probable that overhead construction for high voltages in this country is foredoomed to early scrapping? For low and medium pressures, for distribution purposes in rural areas, it is necessary, but for other purposes it is a timid expedient—a makeshift upon the pretext of economy. Reliability should not be sacrificed lightly, and it will not be economy to spend much money upon vulnerable, arterial, overhead lines in this country. They are liable to grave interference by lightning, birds, and atmospheric deposits over the insulators, which lead to failure. The insulators also invite potshies from the exuberant youth of the districts which such lines would traverse, whilst maliciously-fired rifle or even catapult shots would play havoc at any moment. Further, overhead lines require constant patrol, whilst their life cannot be expected to equal that of a modern cable laid underground.

The soundest course for development appears to be to install modern generating plant, including ample margins of spare, at or near the load centres, and to interconnect with cables when they will improve the degree of reliability or are obviously desirable from other practical points of view. There are many situations where advantage can be taken of the efficiency of large generating units, but much smaller plant can give very efficient results—and better reliability.

There is a national point of view about this matter which is not, perhaps, at once apparent. Generating plant produced in this country very largely utilises our own natural products, such as steel and iron. Our works are equipped for its manufacture, and our artisans and labourers have generations of inborn mechanical skill as their heritage for its making. By employing all this and producing plant for our own use, we shall be able to produce for export at prices which, together with the goodwill which goes with our international reputation for similar products, will further develop our oversea markets and so enrich our home conditions of life.

In the production of cables or overhead lines, most of the materials have to be imported by us, and the proportion of labour cost for manufacture is small, with no bulk of skill.

There is a better case for the development of our electricity supply industry by installing modern plant than by the wholesale scrapping of existing stations merely because they are not large. Let them be made efficient with modern plant, where such plant would enable reasonably low generating costs to be obtained.

* This article was received on February 27th, 1926.—EDS.

Without question, there are many existing stations which should be shut down, and a bulk supply is the obvious need, especially where a more important station is not far away. Bulk supply should always imply a dual supply. When taken, it should be distributed as alternating current, or at least only partially converted whilst the change-over from direct current is effected. In most cases the change-over is but a puny giant if it is fully examined.

This digression upon the theme of reliability and method was necessary for the satisfactory study of future price.

We may expect to achieve average generating costs of 0.3d. per kWh with coal at present prices. If, as seems possible, the price of coal should advance, our average will exceed 0.3d.

With a present consumption of, say, 100 kWh per head of population per annum, the "other costs" amount to 1.5d. per unit. A consumption of 500 units per head suggests the figure of 0.3d. per unit for the "other costs," or the ratio of fifty-fifty previously mentioned. There is no fundamental verity about this particular ratio, but it does appear to bear a certain significance.

Five hundred units per head and a load factor of between 50 and 60 per cent. are not extravagant anticipations, but for a population of fifty millions it gives an output of 25,000 million units per annum, with a top load of five million kilowatts. Allowing reasonable margins for spare, with some interconnection, the total installed plant capacity will be, say, 6 million kilowatts. At £18 per kilowatt installed, the capital sum will amount to 108 million pounds sterling. Interest and depreciation upon this, taken at 10 per cent., amounts to nearly 11 million pounds per annum—about 0.1d. per unit for the output estimated.

For transmission and distribution a similar amount of capital expenditure will be called for, so that this also indicates the figure of 0.1d. per unit.

A further similar item will be required for repairs and maintenance in connection with transmission and distribution, together with management, rates, taxes, accounts, publicity, and reserve.

All charges may therefore be considered as follows:—

	Pence per unit sold.
(*a*) Generation	0.3
(*b*) Capital charges (generation) ...	0.1
(*c*) Capital charges (transmission and distribution)	0.1
(*d*) Recurring expenses	0.1
Total	0.6

Of the above items, (*a*) and (*b*) are common to every load, but (*c*) and (*d*) are subject to apportionment between producing and retailing organisations.

At two-part tariff rates the total revenue requirements are met by a charge of £6 per annum per kilowatt of installed generating plant, plus 0.3d. per unit; or (allowing a diversity of 1.5, including spare plant provision) £4 per kilowatt of the purchaser's maximum demand, plus 0.3d. per unit. The kilowatt charge is capable of further easing by an appropriate division of the items (*c*) and (*d*) as between producer and bulk purchaser.

In the light of these considerations it seems that present-day prices are not so very far removed from the visible limits, at least so far as the bulk of the present output is concerned. It is unfortunate that insufficiently-informed speakers should talk at large about supplies at 1d. per unit. This leads quite satisfied consumers, who are at present paying reasonable prices for lighting and certain other purposes, to expect the impossible. Even popular price cutting is liable to bring an unwelcome reaction in the course of a year or two. We should not forget the advent of the metal-filament lamp, the regrettable audacity of the "point fives," and the possible prices of copper and lead.

The foregoing computations refer, of course, to average figures for the whole country; they imply a range of prices to consumers between about 0.5d. per unit for steady industrial loads of long-hour duration and the present rates for short, overlapping loads of little inherent diversity, such as shop lighting. Domestic requirements, other than lighting, will probably be met, eventually, at an average figure of about 0.6d. per unit. Upon a calorific value basis this figure compares most favourably with coal gas distributed at 9d. per therm.

None of these figures include the enormous volume of business that they predict in house wiring and the installation of motors and other consuming apparatus. Supply authorities must cater for this in its entirety. It will call for large capital expenditure, but since all expenditure can be made profitable from the first through sales, hire-purchase, and simple hire, it can always sustain its own sinking fund, and is not an item of cost in electricity supply.

In conclusion, let it be said that the best-informed supply engineers throughout the country have confidence in the Electricity Commissioners and wish to see them vested with the greater authority which it was originally intended they should have. It is to be hoped that they will remodel the present constitution of joint electricity authorities by establishing smaller councils, with a local Commissioner. The present solemn, but inept, meetings, mainly attended by numbers of delegates from borough and urban councils and some other remarkable bodies, who advise without knowledge, and know as much about electricity supply as they do of gunnery ballistics, are a pitiful travesty of what should be a brisk and efficient zonal organisation. Surely chartered electrical engineers, to whom alone all the credit is due for the flourishing state of our industry to-day, should be the delegates—not the haberdasher or squire who happens to be upon a local council or some other vaguely interested body.

The Law of Contract.

By HERBERT G. CLAYTON, A.I.S.A.

Electrical contractors, especially those in a small way of business, frequently appear to be in some doubt regarding the legal rights and duties imposed on them by various contracts.

One of the first essentials to remember when two parties meet for contractual purposes is that they shall be *consensus ad idem;* that is to say, they must be of one mind regarding their intentions and the subject-matter of the agreement. Otherwise, mistake of purpose will arise, which may result in the contract being invalidated.

A contract has been defined as an agreement, enforceable at law, between two or more parties for the provision of goods or services, in exchange for money or other goods or services. There are three classes of contracts:—

(*a*) Specialty contracts (under seal).
(*b*) Simple (or parol) contracts.
(*c*) Contracts of record.

There are certain cases where it is absolutely necessary to have the contract made under seal, but in modern business this is not usually necessary, and this type of contract has been largely superseded by the simple contract, which, however, must conform to certain requirements to make it legally enforceable. One of the chief distinctions between these two classes of contracts is that the simple contract requires what is technically known as "consideration" to make it binding; whereas in a specialty contract this is unnecessary.

Furthermore, although contracts under seal must be written, witnessed, sealed, and delivered, simple contracts may be written, verbal, or implied. There are a few exceptions to this rule, and the one which is most likely to affect electrical contractors generally is the provision under the Sale of Goods Act, 1893 (Section 4), which enacts that goods to the value of £10 and upwards must be evidenced in writing and signed by the party placing the order, or, alternatively, that there must have been part performance of the contract.

It will be found that whenever a contract has been made there has been an offer to do a certain thing on the one part, and the acceptance has taken place on the other part. It is important to note that the acceptance of the offer must be unconditional, otherwise no contract has been effected, but simply a counter-proposal. The acceptance must also take place before the offer is withdrawn or revoked. As soon as acceptance of the offer takes place in the manner provided, it is conclusive; the contract is complete and cannot be revoked without cause for an action for damages arising.

An important point for electrical contractors is the legal position of offers (*e.g.*, estimates) sent by post. In these cases, the Post Office is deemed to be the agent for the party first using it. Consequently, when an offer is posted by a contractor, the Post Office is deemed to be his agent, and as soon as the customer receives the letter and accepts the terms, the mere act of posting his acceptance completes the contract. It is not necessary to wait until the communication is actually delivered. Conversely, if an offer is withdrawn by post, the revocation does not become effective until the letter has been delivered.

In making a simple contract, it should be noted that there must be valuable consideration to make the agreement enforceable at law. Consideration may be briefly defined as "some interest or profit accruing," which is required to show that it was not a gratuitous promise, as such a promise must be made under seal. For instance, if a promise is made to keep an offer open, this requires consideration, or, alternatively, it must be made in the form of a specialty contract. In addition, a promise to pay a smaller amount in discharge of a larger debt, necessitates consideration (however small) passing; otherwise, even if the smaller amount is accepted, there is nothing to prevent the creditor sueing for the balance at some future date.

The mater of contractual capacity is of importance to the contractor, and it should be noted that all contracts made with minors, except for necessaries, are void (Infants Relief Act, 1874). The exception to this statement is in the case of apprenticeship contracts, which are binding on all parties. The Court, however, if appealed to, will always review such contracts if harsh and unconscionable conditions are alleged, and if and when necessary will grant relief.

In the case of companies, any contract made outside the capacity of the powers conferred in the Memorandum of Association is *ultra vires* the company, and cannot be enforced or ratified. Any contract, however, made *ultra vires* the directors, but within the powers of the company itself, will be effective if ratified by the members of the company.

If there is breach of contract, the usual remedy is an action for damages. When, however, damages would not give the desired result, "*specific performance*" may be ordered by the Court; this sometimes applies to the sale of special goods which cannot be obtained elsewhere.

Damages may be liquidated (assessed in contract) or unliquidated (loss incurred through breach of contract). If a cause for action at law arises, the Court will scrutinise the liquidated damages clause very closely, and if it is apparent that it is really a penalty clause, in spite of its name, the Court will grant relief, the reason being that the Court holds that it alone has the power to inflict penalties.

The London Electrical Engineers.—27TH (LONDON) ANTI-AIRCRAFT BATTALION, R.E. (T.A.).—Officer Commanding, Lieut.-Col. C. H. S. Evans, O.B.E.—The following orders have been issued for May, 1926: 304th Company, Major P. F. Foulger. 305th Company, Major A. W. M. Mawby, O.B.E., Tuesdays, 7 p.m. to 9-30 p.m. 306th Company, Major F. C. Clarke, Monday, 7 p.m. to 9-30 p.m. The Easter Camp at Biggin Hill was well attended. On Friday and Saturday night an aeroplane was engaged by four searchlights; the standard of work done was uniformly good and special mention should be made of one light manned by recruits. All ranks were exercised with sound locators and were fortunate enough to be given a lecture and demonstration on three different types of aeroplanes, by their respective pilots.

Modern Electric Furnace Practice.

A Review of Some of the Methods of Installation and Operation.

By "LAPIS LAZULI."

In fixing the connections for an electric furnace the electrical engineer usually encounters numerous obstacles although, as a rule, none of them is particularly complicated. It may be helpful, however, to outline the process necessary to ensure the correct electrical conditions being maintained. At the outset it will be realised that "arcing" with a current like one employed in a steel-refining furnace is a matter of no small importance, and it largely falls to the duty of an experienced man to see that connections are properly made, and the clutch which carries the current to the electrode must exert an exceptionally firm grip on the carbon. Any slackness in screwing up the clutch, bolting and tinning the bus-bars, and other similar points would lead to disastrous results when the heat developed, as the arc at any slight space obtaining would melt away copper and carbon alike in a few moments. Similar results would be brought about if the arrangement which keeps the electrodes in proper alignment were allowed to move or even vibrate; also if the carbons came into contact with the side of one of the metal holders.

The bus-bars carrying the current from the transformer to the furnace are usually arranged overhead with the phases kept well apart; this is done with a view to preventing accidents when the furnacemen are carrying long pinches, rabbles, and other furnace tools.

The bus-bars are usually connected to the furnace by means of cables; in the arc furnace cables alone are used, but with the arc-resistance type it is customary to extend or divert the bus-bars close to the bottom connections, where a short length of cable is employed to permit the tilting of the furnace. A "box" lug is used for the bus-bar connection. The bus-bars are supported by iron bars, suitably insulated, and wooden spacers are employed. As a rule the transformers are housed in a small chamber adjoining the foundry, with a hole in the wall allowing the bus-bars to be connected directly to the transformer. This space, which is often left open, should be filled in with asbestos or any other suitable insulating material as soon as the installation is completed, as it prevents foundry dust finding its way into the transformer.

Most of the furnaces in this country are employed on a two-phase supply, the h.p. 3-phase supply from the generating station being dealt with by Scott-connected static transformers. The voltage is tapped off as required, with the aid of a selector switch controlled by an oil switch. Current and potential transformers are used in connection with the measuring instruments, and the supply is metered after each "heat," the consumption per ton of steel cast being recorded. Various controlling arrangements are employed on different furnaces, and the switches and other equipment are usually installed on a panel fitted into the wall of the furnace. To bring the current on to the metal in the hearth in the ordinary arc and arc-resistance types of furnace, the electrodes are carefully lowered until the arc is struck.

When the metal is cold the current is liable to surge violently, due largely to the irregular shapes of the pieces of scrap. This is apt to throw out the trip switch, which is brought in again after the electrodes have been raised. As the metal becomes melted the surging decreases, and at the final stages it ceases altogether. A small switch in circuit with the transformer switch coils is used to open the switch immediately in the case of emergency. This is only used in exigencies such as the furnace roof falling in, and arcing at the terminal boxes. The tilting mechanism of the furnace is provided with trip switches, so that the shell cannot be damaged by over-tilting. When the charge is ready for tapping, the electrodes are first raised, the ladle is then brought into position and the furnace tilted.

Arrangements are made to see that the electrodes are firmly fixed, although raised from the actual hearth, as in the tilting there is some risk of their being broken. In the older types of furnace the electrodes were continually being fractured by intermittent exposure, when hot, to the cold atmosphere. In the modern furnaces economisers are used which reduce these losses to a minimum. Current losses are one of the most important points in furnace efficiency, and the proper method of insulation at the leading in and out places of the shell is essential to success in this direction.

Although the Scott-connected transformers are provided complete with switches, it is the usual practice to transport them with the parts dissembled, the reassembling being effected at the steel works. From this it will be observed that such work necessitates a sound knowledge of the process, from the introduction of the high-pressure energy to the final stages of the melting. It should be added that the employment of current regulators has made electric furnaces more acceptable to the supply undertakings, as violent surging is eliminated.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

The Electricity Bill.—We understand that the Electricity Bill will be considered by a Committee of the House of Commons during next week.

Electrical Energy Generated.—On April 15th Mr. H. Williams asked the Minister of Transport if he could state for the year 1925 the amount of electrical energy generated by all authorised undertakers and by railway and tramway companies; and the estimated quantity generated privately.

Colonel Ashley said that the returns submitted by authorised undertakers for the year 1925 had not yet been completely verified. The unchecked returns showed that approximately 6,685,700,000 kWh was generated during the year ended December 31st, 1925. With regard to railway and tramway companies, complete figures were not yet available for the calendar year 1925. Complete data in respect of private generation were not available. A rough estimate, however, from which he saw no reason to differ, was given in the Weir Report that the total national consumption from all sources in 1923 was about 200 kWh per head. During that period the energy generated by authorised undertakers amounted to 4,016,000,000 kWh.

[The last figure is that given in the Weir Report for "Units Sold." The energy generated was 4,572 million kWh.—Eds. Elec. Rev.]

Legal.

Alleged Theft of Electricity.

At the Newcastle (Staffs.) Police Court, on April 15th, John Stanley Cook, electrician, was summoned by the Corporation for the fraudulent abstraction and use of electricity. The Town Clerk, prosecuting, said that the defendant had employed for lighting purposes energy which had passed through a power meter, thereby securing it at a much lower rate. Evidence was given by employés of the Electricity Department to this effect, and one of them admitted that as the lamp in question was fitted it acted as a resistance for the charging of accumulators. Counsel for the defendant maintained that his client had no intention of defrauding the local authority; for twelve months he had openly charged accumulators in his shop, using a 200-W lamp as a resistance. Others in the district also charged batteries in that way. The lamp was only used for illumination purposes incidentally. The magistrates considered that a *prima facie* case had been made out, and committed the defendant for trial at the Borough Quarter Sessions.

Claim for an Electrical Installation.

At Southport County Court recently, Mr. G. H. Turner, electrical engineer, sued a Mrs. Howarth for £18 6s. 10d., balance of account for installing electric lighting to her order. The total bill was stated to be £48 6s. 10d., and his Honour Judge Dowdall said that he had had an electrical installation put in his house, with 27 lights and 30 points, at a cost of £35; it was lead-covered work.

P. Morley, electrical engineer, said that screwed tubing was very expensive. He would not estimate at under £2 a point.

For the defence, G. Littler, electrician, said that he estimated the job at £33 10s. He and an assistant could do the work in a fortnight at the outside; two hundred hours were unreasonable.

His Honour said that he thought the work might have been done more quickly. At the same time, he did not doubt that the time was put in. That would have been a suitable case for arbitration by an expert. He gave judgment for the plaintiff for £15 10s., with costs.

Correspondence.

Correspondents should forward their communications at the **earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

The Fine Regulation of Resistance.

I am afraid I cannot see eye to eye with your correspondent who signs himself "Rheostat." His suggestion that a straight line type of rheostat with 150 contacts will meet all requirements for fine regulation scarcely needs refutation as more steps than this are frequently called for and supplied.

The Multistep Rheostat was designed to meet these requirements, and the fact that it gives 600 uniform steps when the designers of alternators and converters would be content with less, is surely no disadvantage.

During the introduction of railways there were doubtless gentlemen writing to the papers under appropriate pseudonyms pointing out the efficiency of the horse as compared with a steam engine, and whilst the difference between 150 and 600 steps is not so great, it nevertheless represents a small step in advance and one for which there has been a demand for some years past.

R. Amberton.

London, S.W., *April 16th*, 1926.

I read with interest Mr. Amberton's article on the Multistep Rheostat which appeared in your issue of the 9th, and have since had the advantage of seeing the apparatus.

But for the fact that a letter signed "Rheostat" and containing disparaging remarks was published in your issue of the 16th, I would not have encroached upon your space, as the article on the Multistep sets out its characteristics so clearly that I should have thought its utility would have been evident to all technical readers.

It solves an old problem—and in my opinion solves it remarkably well. Moreover, an inspection of an actual Multistep Rheostat shows it to be a simple, well-thought-out piece of apparatus, the only complication being in the inception of the idea, and not in its mechanical or electrical features.

One point occurs to me which Mr. Amberton did not emphasise in his article. With a limited number of steps of the order of, say, 100-150, it is not possible to specify the resistance and stepping of the Rheostat until after the alternator has been built and excitation curves have been plotted. The provision of 600 steps on the Multistep Rheostat will make it possible for the designer of an alternator to allow an ample margin of resistance and not to trouble himself about stepping. He will also have the advantage of having the Rheostat on hand and available as soon as the alternator is ready for test.

C. A. Ablett.

Manchester, *April 17th*, 1926.

I think that "Rheostat" has rather missed the point in his criticism of Mr. Amberton's apparatus.

The plain rheostat of 150 steps is hardly comparable in smoothness of working with one of 600 steps, and the 151 electrical connections needed are very many more than the 85 which Mr. Amberton requires. I do not suppose this gentleman ties himself to 600 steps, but presumably if a 150-step resistance is required it could be made on his principle with a similar large reduction in the number of electrical connections. The fewer these connections are, the easier it will be to keep them clear of one another.

F. A. Greene.

London, *April 17th*, 1926.

Three-phase, 4-Wire Distribution.

I should be glad if any readers would kindly inform me whether the variation of pressure is very marked on a 3-phase, 4-wire supply with unbalanced loads on the phases, using three 3-phase core-type transformers, connected star/star; also whether they would recommend the star/star connection in preference to the delta/star, having regard to the fact that the former permits of single-phase transformation in the event of one of the transformers becoming inoperative.

Inquirer.

April 15th, 1926.

Country-house Fires.

My attention has been directed to a letter in your issue of the 2nd inst., signed J. Price. I think that the statement that insurance companies do not "cause very careful tests to be made" needs some modification, as a perusal of the reports called for by the tariff companies specialising in engineering insurance will show that a definite report is required from the surveyor as to earthing and tests and examination of the earth wire. There are, of course, non-tariff companies which run engineering insurance as a branch and do not insist even on inspections, and it is at these companies that the brickbats should be thrown, as they will generally accept risks which an engineering insurance company has refused for some reason. The greatest stumbling block the surveyor meets with is very often the clients themselves, who object and sometimes refuse to allow the surveyor into those parts, labelled, on the dis. board "Principal Floor—1st Floor

Principal Rooms," &c., to take out lamps or test sub-circuits, so that an insulation test to earth from the main switch over the whole circuit is all that is possible; should the insurance company insist on a full series of tests, the only intimation is that the clients have changed their insurance to another company, generally one which does not insist on inspections. As regards insurance companies and qualified engineers, a little investigation would show that engineering insurance companies require quite as good qualifications of their surveyors as any manufacturer requires of his technical engineers. While it is generally agreed that installation inspections should be compulsory, something is also required to compel occupiers to allow proper tests to be made irrespective of the company with which they are insured.

Engineer Surveyor.

April 15th, 1926.

The Qualifications of a Salesman.

"Qui Pense" raises an important point in the qualifications of an engineer. Box numbers 9739 and 9709 in this issue of the REVIEW both mean:—"We require men who have paper qualifications and have done the same work. At some period of the future we will pay them the sum they have the wit to obtain from us, provided they fit in with our existing staff." Quite legitimate requirements and quite fair, but points to be remembered by men who hope that if they work hard and show keenness their salaries will follow the story books' rule.

I have applied for 100 situations, for 10 of which I held *almost complete* qualifications. Of these ten, three were advertisements "by law compelled" (this form of torture I hope will soon cease) and I was placed on the short list for five.

In the course of these interviews and thinking over them afterwards the following home truths were thrust on me: "Don't accept a temporary or junior job; you might be smythed for a better job or promotion. Don't be a new broom. Don't show too much enterprise or keenness for the job or take your coat off afterwards; this is taboo. See that the sport you take up is the correct sport. Don't like any other."

Nildes.

April 12th, 1926.

Overhead Transmission Lines.

I recently had the opportunity of inspecting an overhead transmission line erected in 1915 and, considering the time it was erected in what may be called open country, was astonished to find the condition of the galvanised ironwork. The channel arms, insulator pins, arm bolts, connecting earth wires, &c., were deeply encrusted with rust, not any galvanising remaining. I can personally vouch for the fact that the galvanising, when the line was erected, was good, and can only attribute the deterioration to the fact that, with the wind in a certain direction, the smoke from an adjacent railway service was carried across the line. Those who have control of overhead lines know, only too well, the difficulties of shutting down for sufficient length of time to allow any extensive repairs to be carried out.

It has occurred to me that, now that rustless steel and iron can be purchased at a more reasonable figure, it would be an eventual saving if all ironwork in the vicinity of the line conductors were made of this material.

If any of your readers have had any experience in this direction I should appreciate a statement of their views, as it seems to be a matter worth looking into, especially when one considers the projected developments.

James Nelson, M.I.E.E., M.I.R.E.

Bristol, *April 15th*, 1926.

Electric Vacuum Cleaners.

Mr. H. Harrison Dent's most interesting article on "Electric Vacuum Cleaners" in the ELECTRICAL REVIEW, contains much that is instructive and helpful to the trader and the user, and, to say the least, some food for thought for the manufacturer.

One must, however, realise that the average user, unless he be of an enquiring disposition, or engaged in engineering himself, has very often neither the time nor the inclination to conduct even the most simple tests when purchasing this appliance.

In fact, there are probably two reasons which make it somewhat difficult in these times to conduct tests as set forth in Mr. Harrison Dent's article, the first being the growing custom for the manufacturer to go direct to the purchaser, ignoring the contractor altogether, and secondly, the practice now, I think, fairly common, for the manufacturer to provide the demonstrator and to give the demonstration for the contractor, at the private residence of the customer.

The result is that the salesman, who is naturally enthusiastic about his machine, allows his enthusiasm to run away with his better judgment, hence wild and extravagant claims are not infrequently put forward by the salesman who desires to bring off the sale.

It is indeed a pleasure to come across cases where, as in the article in question, due recognition and generous tribute are paid to the advantages and merits of each type of machine. Those who have spent many years in the vacuum cleaner industry know only too well the difficulties that beset them and how hard it is to please the housewife. We realise that the salesmen of competitive firms are, not infrequently, anything but guarded in their condemnation of all machines except their own, forgetting that each machine as a rule has its good points, and, I have no doubt, its faulty ones.

It is constructive criticism, such as Mr. Dent's, that manufacturers can turn to in order to find food for thought. He is, however, treading on thorny ground when he speaks about the advantages or the disadvantages of the rotating brush; it is a point around which a sharp controversy always rages, and one which, I readily admit, is as far from being settled as ever.

It is an acknowledged fact that a vacuum which is too powerful does injure the fabric of the carpet if used frequently; at the same time the revolving brush has much to be said against it. I quite agree with Mr. Dent that the impact given to the carpet by the brush is not violent, but it is, nevertheless, an impact which will in time flick the nap of the carpet and take it into the bag. This constant flicking bruises, if I may be permitted to use this phrase, the nap, and it takes some little while before it becomes apparent; a careful examination of the dust in the bag will show this to be the case.

I trust Mr. Dent will pardon me when I take him up for saying that there is no evidence to prove that the revolving brush is injurious to the carpet. I would point out that the evidence is there all the same, without going to America to find it. The evidence is to be found in the constant complaints of users, who frankly say that they do find the nap of the carpet in the bag. Again, I myself have both seen and handled the evidence.

I gladly grant that a brush is a valuable asset; failure to do so would be unjust to the writer and unfair to the vacuum cleaner itself, but I very much doubt if the policy of the rotating brush is to be desired. I will go further, and will admit that, on a thick carpet, cotton is extremely difficult to pick up unless the end of the thread is standing up; a brush, however, is just as effective if fastened on to the front of the orifice of the machine, as in the case of the old type Croydon "Premier," and this practice is, I think, still carried out in the new model.

This brush is only put on when cleaning a room where sewing has been done; it can easily be removed and cleaned, and does not clog the orifice with hair and so forth, thus preventing the suction falling away.

If vacuum cleaners were used by highly instructed maids all would be well, but my experience is that the faults which arise are not so much faults in design as a complete lack of understanding on the part of the operator; she will look after her sewing machine like a young mother looks after her child, while the vacuum cleaner, because it is a vacuum cleaner, and therefore used for dirt and dust, can look after itself.

I do not think Mr. Harrison Dent's test with flour is quite a fair one, when testing a vacuum cleaner, but I will not complain about it. I am certain that he will find that flour retains moisture longer than sand, and is as a rule when dry, not so susceptible to crumbling as ordinary dirt the molecules of which more easily disintegrate as the machine or nozzle passes over it. The difference is very marked indeed.

The whole question of design is one which to my mind—and I speak from having many years' manufacturing experience in this branch of the electrical industry—calls for serious thought on the part of those who, in this country at any rate, are manufacturing cleaners with what I call an open bag. I am convinced more than ever by past experience that the external bag is neither sound nor healthy. It is astonishing what dirt gets through the bag back again into the room; every bag should be placed in the cylinder of the machine as in the case of the Electrolux and the Regina, and proper provision should be made to disinfect the air after it has passed through the dust chamber, and therefore, the bag, before it passes through the motor housing into the room. It means, I know, the scrapping of much material. If only the users could see the dust that is left on the disinfecting pad they would insist on its being adopted. As far as the provision of adjustments for lowering or raising the nozzle of the machine is concerned, I think that Mr. Dent will agree with me when I say that, speaking generally, they are satisfactory. The real trouble is that they are frequently ignored and, if not, are adjusted so carelessly that I do not think I am stretching the point when I say that in the majority of cases the machine is not given a fair chance. I am convinced that in many cases the orifice is as a rule either quarter or in some cases half open, most of the time the machine is in use. I only wish that more users would test machines before buying, then the machine worthy of merit would hold its own, but unfortunately, the public have, it appears, yet to learn that The Good House-keeping Institute is for the purpose of counselling those who want advice about purchasing domestic articles.

Before closing I should like to ask Mr. Harrison Dent what he considers is an adequate suction. I contend that nothing below 16 to 20 inches as measured with a manometer is really effective.

Alec. Sacré.

Sydenham, S.E.26, *April 16th*, 1926.

The Belgian Electricity Supply Industry.—Of six Belgian electricity supply concerns which have recently issued their report for last year, two are paying dividends of 7 per cent. for 1925, while the other four are paying, respectively, 9½, 10, 11 and 12 per cent.

D

The Properties and Engineering Uses of Stainless Steel.

By T. R. WILTON, M.A.

(*Abstract of a Paper read before the* Liverpool Engineering Society.)

Two of the causes of corrosion are direct solution of the material, resulting in a gradual wasting away, and galvanic action, causing selective local attack. In the case of wrought iron the first cause alone operates and in the case of steel both causes operate together. An addition of upwards of 9 per cent. of chromium to mild steel suffices to make the material insoluble in water, and therefore should suppress the type of corrosion which occurs with wrought iron. The problem of the dissimilar crystals in steel is overcome by hardening the material by heat treatment, causing the dissimilar crystals to dissolve one in the other and produce a homogeneous agglomerate. In the production of stainless non-corrosive material, we have to guard not only against solubility in water and dissimilarity of the crystalline bodies forming the structure of the material, but also against selective distortion. Stainless steel finished with heavy cuts will rust on the surface, and the same piece will be found immune from rust if this rough machined surface be removed by fine cuts and finished by grinding. The virtue of the polished surface is that only fine machining and careful grinding can produce it, and the distortion of the surface material is therefore avoided or eliminated. The verdict of experiments has been that contact corrosion diminishes steadily as the amount of chromium present in the steel rises, and that when a figure of 16 or 17 per cent. of chromium is reached, most forms of contact corrosion are eliminated.

It was found that stainless steels containing 16 or 18 per cent. of chromium, without other alloy, had a comparatively coarse crystalline structure, which could not be effectively refined by heat-treatment, and were consequently rather brittle. To overcome this difficulty small percentages of nickel were added, and the result is what is know as Twoscore stainless steel, in which general immunity from contact corrosion is obtained by the use of 17 or 18 per cent. of chromium and where a fine structure and good physical properties are restored to this high-chromium steel by the addition of 2 or 3 per cent. of nickel. Such a material may have in the heat-treated condition a hardness of between 50 and 100 tons per sq. in., according to the composition and the treatment, which makes it serviceable for the great majority of engineering applications. Chromium and Twoscore steels have similar characteristics to high carbon steels, in that they can be hardened, if reheated to suitable temperatures, and then either cooled in air or quenched in oil, or even, in extreme cases, water.

The presence of a high percentage of chromium in steel, in addition to making it non-corrosive at atmospheric temperatures, renders it also practically immune from oxidation at high temperatures. Straight chromium steels may resist oxidation or scaling up to temperatures between 800 deg. and 1,000 deg. C., or even higher, depending on their chromium content, and high-chromium-nickel alloys may resist oxidation up to temperatures of 1,100 deg. C. This property is extremely valuable in such applications as inlet and exhaust valves for internal combustion engines. Further, straight chromium steels are stronger at high temperatures than ordinary carbon steels, and the high-chromium-high-nickel steels, are stronger still at high temperatures. This property is extremely valuable in exhaust valves for internal combustion engines, enabling them to resist deformation under repeated impact when working red hot, and the possibility of constructing gas turbines in the near future probably turns upon the use of such alloy steels. In hydraulic machinery at a steel works the author has found the life of packings with stainless rams to be from 3 to 10 times that with ordinary steel or bronze rams.

For some reason that we cannot yet explain, stainless steel will not slide on stainless steel under pressure without seizing. The best slide-valve combination, known by the author, uses stainless steel for one of the sliding faces and a nickel-copper alloy for the other.

The blading of both impulse- and reaction-type turbines is another field which has been strongly invaded by stainless materials. The original machines were all bladed with bronze, which had many characteristics. It was readily produced in blading profiles, either by extrusion or by cold-drawing; it was easy to solder or braze in ways of shrouding bands; and it was soft and easy to machine. But with the advent of higher steam pressures and considerable superheats, bronze blading could no longer stand up to the work, and trials were made with steel. The most popular steel up till recently was mild nickel steel, generally 5 per cent. of nickel being used. Very high nickel steels (25 per cent.) have been used, but prolonged exposure to high steam temperatures induces extreme brittleness in this material. Cases of disastrous blade-stripping have occurred from this cause. But the low nickel steels, while physically stronger than bronze, suffered from corrosion, and in impulse turbines, from erosion and pitting. Within the past three or four years many of the largest turbine builders have adopted stainless-steel blades either exclusively or very extensively.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

Wages in the Contracting Industry.—The National Federated Electrical Association, while unable to agree to the Electrical Trades Union's request for the restoration of the 5 per cent. "cut" made in 1923, has decided to revert to the National Sliding Scale Agreement of September, 1921, by which wages rise and fall in accordance with the cost-of-living index. The hourly rates to be adopted, as from the week covered by the pay-day April 30th or May 1st, are as follows:—Grade A, 1s. 10½d.; Grade B, 1s. 8½d.; Grade C, 1s. 6½d.; and Grade D, 1s. 5½d. We are informed that this implies a general increase of ½d. per hour.

"Buy British Goods."—At a luncheon of the London Commercial Club last week, Sir Philip Cunliffe-Lister, President of the Board of Trade, said that the placing of orders at home not only meant more employment but increased the volume of trade and enabled prices to be reduced, giving British manufacturers a better position in foreign markets. The Government was practising what it preached. The G.P.O., one of the biggest buying departments, only purchased ¼ per cent. of its requirements abroad, and the foreign purchases of the Stationery Office were only 1½ per cent. On behalf of the Government he appealed to local authorities to adopt the same policy; some were not buying British goods. Another matter in which these authorities could be helpful was in standardisation of requirements.

City Electricity Charges.—The report of the special committee on electricity charges, which was reviewed in our last issue, was presented to the City of London Corporation on April 15th. Mr. Deputy Sandle said that although the protests of the Corporation and the London Chamber of Commerce had borne some fruit, the prices were still too high. During the past seven years the companies had been able to put to reserves a sum equal to the whole of their ordinary capital, in addition to paying dividends totalling 101 per cent. in the case of the City of London Electric Lighting Co. and 82½ per cent. in the case of the Charing Cross Co. Mr. Sandle quoted figures showing that large firms in the City paid the companies twice as much for electricity as they would have had to pay Stepney Borough Council if that body had been able to supply them. The Corporation adopted the report which, it will be remembered, recommended that further action should be deferred until the results of the working of the London Electricity Acts were seen.

A "Stay-In" Engineering Strike.—The employés of Messrs. R. Hoe & Co., who were recently involved in the strike which threatened to lead to a national lock-out, suspended work without leaving the shops on April 14th. The reason for their action was stated to be the transfer of a foreman from one shop to another. The A.E.U. discountenanced the strike. The men resumed work on the following day, an agreement having been reached.

Unemployment.—The Employment Exchange registers for April 5th showed an increase—the first for some weeks. At that date the number of wholly unemployed persons was 1,049,800, as compared with 1,013,609 on March 29th and 1,166,353 on April 6th, 1925. The increase is said to be due to temporary stoppages at Easter.

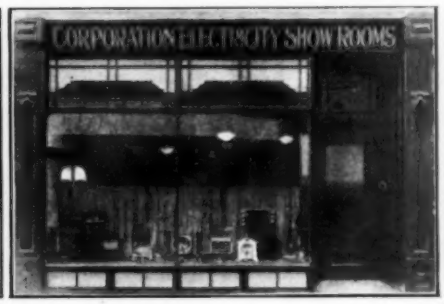
The Canadian Budget.—Mr. Robb, the Dominion Finance Minister, introduced his Budget in the Canadian House of Commons last week. Among the points in his speech were announcements that the two-cents post would be restored on July 1st; that the British preferential tariff, after January 1st next, would only apply to goods conveyed directly to Canadian ports; that the income taxes would be substantially reduced; and that the duty on equipment for generating electricity for farm purposes was to be reduced to 5 per cent. under the British preferential tariff, and to 10 per cent. under the intermediate and general tariffs.

Registered Contractors.—The following contractors were approved for registration at a meeting of the Executive Committee of the National Register of Electrical Installation Contractors at its meeting on April 9th:—

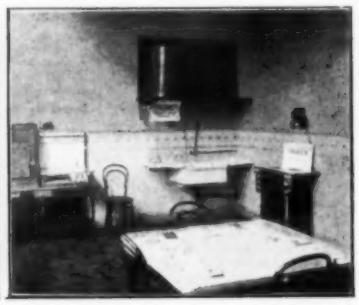
Dodd, W. G., Ltd., Ayr.
Gilliver & Crouch, S.W.1.
Truman Electrical Co., Walsall
Henderson, T., Durham
Stearn, R. J., & Co., Luton
Brewster, G. M., Manchester
Gillies, G. & Co., Ltd., Kendal
Milsted, C., & Sons, Tenterden
Sandon Motor & Engineering Co., Ltd., Liverpool.
Bannister, J. D., Padiham
Harvey, E. A., Nottingham
Hynds & Co., Belfast
Napier & Wheeldon, Hull
Glover, E. & H., Darlington
Elphick, C., Tunbridge Wells
Read & Partners, Ltd., S.W.1
Hardy, G. A., Leek.
Williamson, W. M., S.E.22
Beckett & Wheatley, Aston, Birmingham
Long, T. J., & Sons, Hexham-on-Tyne
Ajax Co., Ilford
Giffen, R. A., St. Albans
Andrews, H. A., Dublin
Laws, H., Ashington
Walsall Electric Supply Department
Cunningham, J., Pollokshields, Glasgow
Parkin, E., & Son, Newport, Mon.
Dalbeattie Electric Light & Power Co., Ltd.
Watson, A., & Dundas, Partick, Glasgow
Alden, F. G., Oxford
Bonham, J., & Co., Willington Quay-on-Tyne

New Municipal Showrooms.—On April 8th, the Mayor of Birkenhead opened the Electricity Supply Department's new showrooms in Grange Road West. The popular Jacobean style has been adopted in the decoration of the new premises and a very comprehensive collection of appliances has been gathered together. As will be seen from the accompanying illustrations the showrooms have an attractive exterior. A large number of lighting fittings are displayed, and each is separately switched to enable it to be demonstrated. In the same apartment vacuum cleaners, fires, fans, and many other appliances are shown. In accordance with the invariable practice a part of the showrooms has been set aside as an electric kitchen for the exhibition and demonstration of electric cooking, water heating, &c., while another section is devoted to laundry appliances—washing machines, a wash boiler, and an ironer.

Fittings Showroom.



Exterior.



Kitchen.

New Showrooms at Birkenhead.

PAISLEY.—The Electricity Department is acquiring extensive premises at 4, Abercorn Street, which are near the centre of the town, and these are to be altered and fitted up as meter workshops, cooker and repair stores and workshops, and they will also be used as temporary showrooms. It is hoped that when the widening of the principal street is completed, premises will be allotted to the Electricity Department for showrooms and offices.

ILKLEY.—As an alternative to spending £5,500 on a new showroom and offices for the Electricity Department, the Ilkley Town Council is considering a proposal to utilise the existing public library for the purpose.

Engineering Employés' Wages.—Last week the Engineering and Allied Employers' Federation offered to increase the "war bonus" paid to engineering employés by 2s. 6d. per week, but at the same time stipulated that the rates for overtime and night work should be reduced. The trade unions concerned stated that the offer was unacceptable, as many men would actually suffer a reduction of wages. They intimated that an offer of an increase of 2s. 6d. unhampered by conditions would be considered worthy of putting to the vote of their members.

At a meeting of representatives of trade unions in the London District, sanction was given to a ballot of members to decide upon strike action to enforce the men's claim for an increase of 20s. per week. The papers will be returnable by May 31st.

Brazilian Railway Electrification Contract.—It is reported from Rio de Janeiro that the Metropolitan-Vickers Electrical Export Co. has been awarded a contract for the electrification of one of the lines of the Western of Minas Railway.

For Sale.—Liverpool Corporation Electric Supply Department has for disposal six Willans engines, direct coupled to Siemens 550-V d.c. generators, seven Lancashire boilers, one 350-tube economiser, draught fan, feed pumps, &c. The Electrical and Mechanical Officer, Catterick Camp, invites offers for two 150-kVA, 440-V generating sets. Mr. H. J. Shaw will sell by auction on May 4th, at 3, 5 and 7, Southville, Wandsworth Road, S.W., wireless and electrical material, machinery, plant, &c., and on May 6th and following day, at 13, High Holborn, various stocks of wireless material, valve and crystal sets, &c. (See our advertisement pages today.)

The Swedish Industries Fair.—The Swedish Industries Fair will be held at Gothenburg from May 6th to 13th next, in the magnificent exhibition building of 30,000 sq. metres floor area, which was originally erected for the engineering section of the Gothenburg Exhibition a few years ago. It is said to be the largest timber structure in the world. The Fair this year will be particularly comprehensive, and certain sections, such as leather and rubber goods, radio, travelling requisites, arts and crafts, and a separate department of inventions should be especially attractive and interesting.

"British" Electrical Goods in New Zealand.—According to the *Daily Mail* Christchurch (N.Z.) correspondent, the Wellington Chamber of Commerce is investigating the action of certain English firms in shipping goods, notably electrical fittings, to New Zealand at prices greatly below those of other British makers. It is alleged that these goods are of German manufacture, are imported to England, and re-shipped to New Zealand as articles of British manufacture, thus paying lower rates under the preferential Customs tariff.

Electric Cookers for Employés.—At the Wakefield City Council meeting last week, objections were raised to a proposal that three members of the Electricity Department staff should be allowed the use of electric cookers in their homes for purposes of demonstration to prospective purchasers. Ald. Emmett said that the loan of the cookers would cost not more than £2 per year, and they were intended not for the men themselves but for their wives to demonstrate electric cooking to people who were interested and could thereby see practical daily use which was impossible in a showroom. The employés concerned paid for the energy used and it was a very cheap advertisement for the department. The recommendation was approved.

Book Notices.—"Chemical Engineering and Chemical Catalogue" (pp. 366). London: Leonard Hill. Price 15s. This is the second edition of a very complete guide to the chemical industry and its products, and electrical manufacturers are well represented. A foreword and an article on "Corrosion" are contributed by Sir Robert Hadfield, Bart., and a large amount of data and tables is given. The volume has been edited by Mr. D. M. Newitt, Ph.D., D.I.C., &c.

"The English Electric Journal," March, 1926. London: The English Electric Co., Ltd.—This issue of the journal is of particular interest for its contents consist mainly of pictures of plant supplied to all parts of the world by the company. Railway electrification is given special prominence.

"An Introduction to Refrigeration." Published by the Technical Section, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's Square, London, S.W.1. Price 2s.

"Relay Handbook, 1926." Pp. 13 + 1,001; figs. 749. Published by the National Electric Light Association, New York. Price to members, $4.00; non-members, $6.00.

"Telephone Repeater Stations."—This 32-page, fully illustrated handsome souvenir publication from the Peel-Conner telephone works of the General Electric Co., Ltd., is a reprint of a description of the repeater stations on the London to Bristol trunk telephone cable. They were the first two of the new series of permanent stations to be completed in connection with the underground trunk telephone cable system, and were put in service in June, 1924, since when they have been in constant commercial use without developing any kind of fault whatsoever. The whole of the repeater equipment was manufactured at the Peel-Conner telephone works at Coventry, and the power plant at the Witton works of the G.E.C.

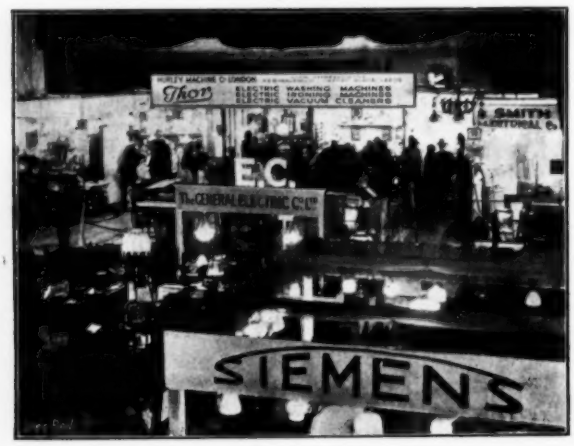
"Les Moteurs à Explosion," by E. Marcotte. Pp. 216; 61 figs. Paris: Librairie Armand Colin. Price 8 fr. 50.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLIV, No. 4. April, 1926. New York: The Institute. Price $1.

Recent Contracts.—MESSRS. FERRANTI, LTD., inform us that they have recently secured two important contracts from the Southern Hemisphere. The first is for six 10,000-kVA, 3-phase, 33,000-V transformers for the Sydney City Council; the other comprises seven 5,000-kVA, single-phase transformers for use as 15,000-kVA, 110,000-V groups, for the New Zealand Public Works Department. The total value of the two orders is approximately £40,000.

New Metro-Vick Showrooms.—On Monday last a party of the Press was conducted over the new showrooms, offices, &c., which the Metropolitan-Vickers Electrical Co., Ltd., and Metro-Vick Supplies, Ltd., have opened in Charing Cross Road, W.C.2. The company was afterwards entertained to luncheon at Frascati's Restaurant. Sir Philip Nash, K.C.M.G., presided, and in a short speech welcomed the visitors, stating that this country had three great things in its favour, electrically speaking:—We had a great deal of headway to make up; we had the ability and the finance to undertake any task; and there existed a most able Press. The company realised that the domestic appliance business had only just started growing, and it had become essential for manufacturers of heavy plant to produce smaller current-consuming devices which brought in a steady income. Sir Philip said that the company was erecting similar premises in Glasgow to cover the important Scottish area.

Local Exhibitions.—KEIGHLEY.—We reproduce herewith a view of the recent exhibition organised by the Corporation Electricity Committee in the Keighley Municipal Hall. The



Electrical Exhibition at Keighley.

show was well supported by both national and local concerns, as will be inferred from the picture.

BRADFORD.—The Corporation Electricity Committee has been awarded a silver medal (second prize) for its stand at the recent Bradford Ideal Homes Exhibition. It is reported that good results were secured from participation in the show.

EVESHAM.—We recently made mention of the electrical exhibition at Evesham, organised by the Shropshire, Worcestershire, and Staffordshire Electric Power Co. One of the

The B.T.-H. Stand at the Evesham Exhibition.

exhibitors at this show was the British Thomson-Houston Co., Ltd., which displayed lighting fittings and domestic appliances upon the stand depicted in the accompanying illustration. The company also supplied the lighting fittings for a model shop window arranged by the organisers.

MORECAMBE.—In connection with the Morecambe Trade Revival Fashion Exhibition being held at the Winter Gardens from April 21st to 28th, the Morecambe Corporation Electricity Department has 10 stands displaying electricity in the home. Demonstrations are being given of cookers, vacuum cleaners, washing machines, boilers, irons, &c., and in addition there are special films and illustrated lectures. Mr. W. H. Wilkinson, A.M.I.E.E., is also exhibiting a variety of labour-saving devices, including ventilating fans, cookers, geysers, &c., and Mr. W. B. Duckworth, radio and electrical engineer, also has an exhibit.

Lead.—Messrs. James Forster & Co. reported on April 17th that there was little change in the general position. It was hoped that present values for lead would bring out more buying from consumers but there was no evidence of this, the demand from cable makers in particular being distinctly disappointing. It seemed likely that until definite signs of an upward movement appeared consumers would continue their policy of buying from hand to mouth. The Board of Trade returns for March showed:—Imports, 19,148 tons; exports, 1,897 tons; leaving for home consumption, 17,251 tons.

Birmingham National Trades Exhibition.—The exhibit of the City of Birmingham Electric Supply Department at this show, which is open from March 15th to May 8th, takes the form of three model rooms of an "all electric" house, *viz.*, dining room, bedroom and kitchen. In the dining room the furniture is dark oak with fittings of oxydised copper. A three-light lantern fitting is placed in the centre of the room for general lighting, and two drop lights fixed near the overmantel are a unique feature. A reading lamp and floor standard are also provided. The heating is supplied by a "Magicoal" fire, supplemented by a 2-kW "Premier" fire. Other appliances shown are a hot plate, small urn, kettle, fan and vacuum cleaner. A bowl fitting is fixed for lighting the bedroom with a cord adjustable pendant over the dressing table, and a table standard near the bed. A tray containing a coffee percolator, toaster, &c., is placed by the bedside. On the dressing-table are an electric hair dryer and a pair of curling tongs. Two fires are shown, a 3-kW "Arora" and a 1-kW

The Birmingham Electric Supply Department's Stand.

"Sturge-Baker." In the kitchen there is an interesting display of domestic apparatus consisting of a "Heatrae" geyser, a "Frigidaire" automatic electric refrigerator, a cooker as supplied on hire, a "Creda" wash boiler, a "Giljay" battery-charging set, &c. A totally-enclosed lighting unit is installed, provided with an adaptor for use with small appliances, kettle, iron, &c. This "room" is illustrated in the accompanying picture.

New Businesses Registered.—The following businesses have recently been registered under the Business Names Act:—

Rotherham Wireless Co. (radio factors), 151, Fitzwilliam Road, Rotherham.

R. Egerton & Co. (electrical engineers and contractors), 26, Pear Tree Street, Derby.

F. H. Barrett & Co. (electrical, radio, and general engineers), 2a and 2b, Church Street, Staines.

Canning Electro-Plating and Engineering Works (electro-plating and scientific instrument makers), 1a, Canning Crescent, Wood Green, N.22.

The Regent Radio Co. (radio distributors), 50-51, High Holborn, W.C.

The London Radio Store (wireless sets and components), 107a, High Street, Uckfield, Sussex.

J. W. Markland (electrician), 89, Old Street, Ashton-under-Lyne.

Gillitt & Co. (sports and wireless outfitters), 22, Lowther Street, Whitehaven.

Central Electric Co. (Watford) (electrical engineers and contractors and wireless dealers), Water Lane, High Street, Watford.

Volume Crystal Manufacturing Co. (wireless and sports goods), 234, Green Street, Bethnal Green, E.2.

Trade Announcements.—The LONDON ELECTRIC WIRE CO. AND SMITHS, LTD., have opened branch offices as follows: Newcastle, 93, Pilgrim Street; Manchester, 19a, Brazennose Street; Liverpool, 63, Moorfields; Leeds, 2, Cabinet Chambers, Basinghall Street. An agency arrangement has been made with Mr. A. Tracy Cross, Circus Street Chambers, East Circus Street, Nottingham. Stocks of cotton, silk and enamelled wire, resistance wires, "Glazite" and "Lewcos" inductance coils are now held in Glasgow, Newcastle, Manchester, Liverpool, Leeds, Nottingham, Birmingham, Coventry, Cardiff, and London.

MESSRS. KENT BROS. ELECTRIC WIRE CO. & E. H. PHILLIPS, LTD., have appointed Messrs. John Grogan & Co., 95, Waterloo Street, Glasgow, as their representatives for Scotland.

THE MAIDENHEAD RADIO CO. has taken premises at 40, Queen Street as showrooms for wireless apparatus and electrical supplies.

MR. W. S. JACKSON, electrical contractor and wireless expert, has opened premises at 8, Walton Road, Stockton Heath, Warrington.

MESSRS. JOHN RICHARDS & CO. (ELECTRICAL ENGINEERS), LTD., having opened branch offices and showrooms at 22, Bore Street, Lichfield, ask for catalogues, &c.

MR. H. A. GREENFIELD, electrical engineer, &c., Norwich, has removed to 48, Bethel Street.

MR. J. E. FOWLER, electrical engineer and contractor, has opened new showrooms and offices at Corn Exchange Buildings, Market Street, Wakefield.

Communications for MESSRS. FESCOL, LTD., should be sent to their new works: 101, Grosvenor Road, Westminster, London, S.W.1. Telephone Nos.: "Victoria 2622 and 2623."

THE UNIVERSAL ELECTRIC LAMP CO., LTD., is removing on 26th inst. to larger offices at 35, Hatton Garden, London, E.C.1.

On the retirement of Mr. Donald Murray from business, the agency for the Morkrum-Kleinschmidt Corporation, of Chicago, has been taken over by STANDARD TELEPHONES & CABLES, LTD. (formerly Western Electric Co., Ltd.), of Connaught House, Aldwych, W.C.2. The Standard Company has already had considerable experience in printing telegraph apparatus, principally in connection with the Western Electric Multiplex system, and the addition of the Morkrum-Kleinschmidt apparatus, including the "Teletype," will materially increase the activities of this company in the telegraph field. It is contemplated that, with the development of its factories which is now taking place, the Standard Company will commence manufacturing "Teletype" apparatus in England.

Catalogues and Lists.—MESSRS. GEORGE ELLISON, Perry Barr, Birmingham.—List No. 327, containing illustrated details of totally-enclosed brake solenoids or power magnets for d.c. circuits up to 300 A and 660 V.

BATTERIES, LTD., Crabbs Cross, Redditch.—List No. 2, describing the company's "Nife" accumulators (nickel-iron type). Priced.

MESSRS. L. WEEKES (LUTON), LTD., Luton, Beds.—A priced and illustrated catalogue of switch- and fuse-gear, including mining-type apparatus.

MESSRS. BERRY, WIGGINS & CO., LTD., Stratford Market, E.15.—A list of electrical compounds for joint boxes, cable troughs, accumulator sealing, &c.

THE D.P. BATTERY CO., LTD., Bakewell, Derbyshire.—An illustrated booklet describing electric locomotives for military purposes.

MESSRS. LACY-HULBERT & CO., LTD., 91, Victoria Street, S.W.1.—List E.O.3, dealing with the "Boreas" electrically-driven tire inflator.

MESSRS. FERRANTI, LTD., Hollinwood, Lancs.—Pamphlets Wa. 401, 402, and 403, describing the "Ferranti" l.f. radio transformer. The last pamphlet is a set of instructions as to the proper use of the instrument. Also Pamphlet Ta 156, dealing with high-voltage d.c. testing equipments.

THE WEINBAU INCANDESCENT & ELECTRICAL CO., 327-335, Commercial Road, E.1.—A net price list of electrical materials and accessories.

SWITCHGEAR & COWANS, LTD., Elsinore Road, Trafford Park, Manchester.—Descriptive Section No. 3-2, advertising remote controlled safety gate-end starters with special protection for use in mines.

BRITISH BROWN-BOVERI, LTD., Trafalgar House, Waterloo Place, S.W.1.—Pamphlet 893E, containing an illustrated description of electric locomotives supplied to the Paris-Orleans Railway.

ELECTRICAL APPLIANCES (BLACKPOOL), LTD., 5, Bloomfield Road, Blackpool.—A priced and illustrated folder advertising switch-plugs and sockets.

VENTEX ELECTRICAL CO., 220, Cooksey Road, Small Heath, Birmingham.—A price list of "Ventex" ironclad cut-outs, distribution boards, &c., and a pamphlet dealing with the "Ventex" time switch.

STELLA LAMP CO., LTD., Winchelsea Road, Harlesden, N.W.10.—An illustrated and priced catalogue of vacuum and gasfilled lamps, including special types.

THE IGRANIC ELECTRIC CO., LTD., 149, Queen Victoria Street, E.C.4.—Publications Nos. 6,215, 6,218, and 6,220, dealing, respectively, with "Xllos" inductance coils; the "Indigraph" vernier knob and dial; and the "Igranic" super-heterodyne receiver outfit. Illustrated and priced.

MESSRS. MARRYAT & SCOTT, LTD., 57, Hatton Garden, E.C.1.—A well-produced catalogue of electric lifts (91 pp.). The publication is profusely illustrated and contains several pictures symbolising the main characteristics of the company's lifts.

KODA (LONDON), LTD., Koda Works, Byfleet, Surrey.—A pamphlet advertising primary cells and batteries.

MESSRS. S. G. LEACH & CO., LTD., 26-30, Artillery Lane, E.1.—List LM.1/26, containing details and illustrations of "Leach" motors, dynamos, motor-generators and converters.

Bankruptcy Proceedings.—JOSEPHINE R. HEREFORD-LAVEY and VIOLET DE FRECE (carrying on business as the Radio Cash Stores), 371, Upper Street, Islington, Leeds, and Nottingham.—The debtors attended before Mr. Registrar Mellor at the London Bankruptcy Court on April 13th for public examination upon a joint statement of affairs showing liabilities of £1,111 and assets "nil." The Official Receiver reported that, in addition to the above liabilities, there were claims amounting to £361 which had not been scheduled by the debtors, and the accounts would consequently have to be amended. According to the debtors' statements, in June, 1924, in partnership with another person, they began business as radio accessories dealers at Leeds, the debtor De Frece providing in all £800 capital. The business was successful, and in August, 1924, the third partner retired, receiving £150. The debtors subsequently removed it to other premises in Leeds, and later opened similar businesses at Islington, Swansea, and Nottingham, all of which were placed under management. The trading resulted in a loss of £300. In February, 1925, execution was levied at all the business premises at the instance of a judgment creditor, and the whole of the stock was seized and sold and the business ceased. The debtors attributed their failure to a slump in the wireless trade, to the heavy increase in the overhead expenditure in connection with branches, and to bad management and irregularities on the part of certain employés. The examination was adjourned for a month, and the debtors were directed to lodge the amended accounts within a fortnight.

JOHN RUSS, electrical goods dealer, 22-23, Verulam Street, Gray's Inn Road, W.C.—This debtor attended before Mr. Registrar Mellor at the London Bankruptcy Court on April 13th for public examination upon accounts showing total liabilities of £8,641 (unsecured £8,630) and net assets valued at £7,446. In reply to Mr. Armstrong, Official Receiver, the debtor stated that he was born in Schleswig-Holstein; he came to this country in 1899, and was naturalised in 1910. He served in the Army in England from August, 1918, till February, 1919. In October, 1920, he entered into an agreement with a German company under which he carried on business in partnership with them in the sale of electrical goods, first from his private address at Highams Park and afterwards at Verulam Street, the arrangement being that the company should finance the business, which he managed without supervision. The agreement was cancelled in 1924, and he continued the business on his own account from the same address until, realising his hopeless financial position, he filed his petition in August, 1925. He attributed his insolvency to the failure of the before-mentioned German company, as his partners in the business, to finance it to the extent to which they had promised; to liability for the payment of partnership debts since the date of the cancellation agreement, &c. The assets included a sum of £5,914, which he alleged to be owing to him from the German company. The examination was concluded.

A. E. BURR (trading as Read & Burr), wireless manufacturers' agent, late of Hammersmith Terrace, W., and Red Lion Court, Fleet Street, E.C.—The first meeting of creditors was held on April 16th at the London Bankruptcy Court. The receiving order was made on April 1st upon the petition of the Rexo Engineering Co. According to the debtor's statement, in April, 1925, he rented a stand at the British Empire Exhibition, and the venture proved a failure, and subsequently, having come to the end of his capital, he ceased business. The liabilities were roughly estimated at £400, and no assets of any description were disclosed. The debtor attributed his failure to the small turnover and heavy expenses at Wembley, depression in wireless trade in 1925, and insufficient capital. The case was left with the Official Receiver to be wound up in bankruptcy.

E. H. NEWMAN and DORIS E. NEWMAN (trading as Newman and Co.), radio and electrical engineers, Shepherd's Bush Green, W.—These debtors attended on April 16th before Mr. Registrar Francke at the London Bankruptcy Court for public examination upon accounts showing liabilities of £793, against assets valued at £45. They commenced business in partnership in January, 1925,. The failure was attributed to lack of capital, heavy overhead expenses, and trade depression. Upon the application of the Official Receiver, the debtors were ordered to furnish cash and goods accounts, and their further examination was adjourned until June. The following are creditors:—

	£		£
Birnard's Press	33	Morton, Burt & Co., Ltd. ...	28
Goswell Engineering Co.	111	Radions, Ltd.	67
S. T. Hill	65	Sparks Radio Supplies, Ltd. ...	27
J. Hollingsworth	125	Stella Products	31
Listron	32	Sylvex, Ltd.	35
Linno Radio Valve Co.	28	Wireless Electric Wholesale Co.	30

W. J. KIDD, electrical engineer, Townhall Street, Enniskillen.—This debtor appeared before Mr. Justice Brown, in the Ulster Bankruptcy Court, Belfast, on April 16th, for examination. Kidd said that he started business in August, 1924,

with a capital of £30, and was adjudicated bankrupt in February last with liabilities amounting to £1,500. He said there were debts due of £85. He had not kept any books. The examination was adjourned.

C. Hubbard, 13, Magdalen Street, Norwich, electrician and wireless dealer.—The receiving order in this matter was made on March 19th on debtor's own petition. The statement of affairs shows liabilities of £472, while the assets are estimated at £709, from which preferential claims of £32 have to be deducted, leaving net assets of £677, or an estimated surplus of £205. In October, 1923, debtor started trading on his own account at Magdalen Street, Norwich, having saved about £300, which was his available capital apart from stock which he had created in his spare time. The Official Receiver states that debtor seems to have allowed too much credit and has not had sufficient capital at his disposal to carry on business on these lines. First meeting, April 23rd, at the Official Receiver's office, 9, Queen Street Chambers, Norwich; public examination, May 11th, at the Shirehall, Norwich.

W. C. Rhodes, trading as L. J. Palmer & Co., Corporation Street, Birmingham, electrical engineer and contractor.—The application for discharge of this debtor was heard on April 15th at the Court House, Birmingham. The proceedings took place in 1925. The liabilities totalled £749 and the assets realised £80, a dividend of 1s. 8d. in the £ being paid. An immediate discharge was granted, subject to debtor's consenting to judgment for £50.

A. North and F. North (A. & F. North), wireless and electrical engineers, 38, Bradford Road and Market Place, Dewsbury.—Receiving order made April 9th, on debtors' own petition. First meeting April 20th, public examination May 6th, both at the County Court House, Dewsbury.

J. McFadden, electrician, 177, Higher Hillgate, Stockport.—Receiving order made April 9th on debtor's own petition.

M. Kelly, radio apparatus dealer, 12, Jackson's Row, Manchester.—Trustee, Mr. J. F. Warburton, 28, Queen Street, Manchester, appointed April 9th.

Company Liquidations.—Bucks. Electric Wire and Engineering Co., Ltd., North Street, New Bradwell.—A meeting of creditors was held on April 15th at the office of Messrs. Corfield & Cripwell, E.C., when the chair was occupied by Mr. W A. J. Osborne, who had been appointed to act as the liquidator in the voluntary liquidation of the company. A statement of affairs was presented which disclosed liabilities of £2,879, and net assets of £290, leaving a deficiency of £2,589. Mr. Osborne stated that the company was formed in March, 1924, with a nominal capital of £500. The turnover from January, 1925, to February, 1926, was £4,822, and there was a gross profit of £644, and a net loss of between £500 and £600. When the company was formed, it took over liabilities of £1,183, and the whole of them had been discharged. In August, 1924, £300 was raised on debentures, and in the following month a further £200. In March, 1925, a further £800 was raised on debentures in favour of Mr. Bullard. At a later date a Mr. Kibble advanced £1,000 on the security of the freehold premises, and the debenture holder was paid out. It was decided that the voluntary liquidation of the company should be continued with Mr. Osborne as the liquidator. The following are creditors:—

	£		£
Bowen Davies, E.	22	Kaye, E. E., Ltd.	275
Coquantin, M.	100	Midland Auto & Engineering Co.	22
Derricott, ...	60	Musk, Beattie H.	43
Gibert, J., & Sons	168	Patman, H.	255
Gurney, A. W.	43	Powell Bros.	194
Hyde, A. H.	381	Townsend, W. H.	369
Hill, Vellacott & Co.	52	Townsend, A. H.	20
Hyde, J. B., & Co.	60	L.M. & S. Rly. Co.	54
Kibble, A. J.	82		

Wireless Installations, Ltd.—Liquidator, Mr. G. D. Pepys, Official Receiver, Carey Street, W.C., released April 13th.

British Electric Vehicles, Ltd.—A petition for the winding up of this company has been presented to the High Court by Batteries, Ltd., of Crabbs Cross, Redditch, creditors, and will be heard in London on April 27th.

Union Electric Welding Co., Ltd.—A meeting of members is called for May 18th at 81, Cannon Street, E.C., to hear an account of the winding up from the liquidator, Mr. L. O. Huggins.

Tele-Dis Services (Founders Co.), Ltd.—Last day for proofs for dividend April 28th. Liquidator, Mr. G. D. Pepys, Official Receiver, Carey Street, W.C.

Dissolutions of Partnership.—Egerton, Jobey & Co., electrical engineers and contractors, 26, Pear Tree Road, Derby.—Mr. H. W. Jobey and Mr. R. E. Worsley have dissolved partnership. Debts will be attended to by Mr. Worsley.

Thornton & Evans, electrical and motor engineers, 37, Regent Street, and The Garage, Lambpit Street, Wrexham.—Mr. S. Thornton and Mr. A. Evans have dissolved partnership.

Private Arrangements.—P. R. Masheder, wireless engineer, trading as "Radio Services," 63a, Stanley Road, Bootle, Liverpool.—A meeting of creditors was held recently, at the offices of Mr. Parkin S. Booth, Liverpool, when a statement of affairs was submitted which showed liabilities of £501, and net assets of £114, leaving a deficiency of £387. It was reported that the debtor commenced business at his present address in December, 1924, with a borrowed capital of £200. He was able to trade successfully until the end of 1925, when the takings fell off considerably, mainly owing to the fact that a fire broke out on the premises and destroyed a large number of batteries which he used in his battery service. A resolution was passed confirming the deed of assignment already executed with Mr. Booth as trustee, whilst a committee was appointed consisting of the representatives of the General Electric Co., Ltd., Messrs. Baxendale Bros., Ltd., and Messrs. Wm. Allan & Co. The following are creditors:—

	£		£
Allan, Wm., & Co.	63	Baxendale Bros.	61
Anderson, Thomas & Co. ...	201	General Electric Co., Ltd. ...	43
Blake, J., & Co., Ltd.	33	Pulford Bros., Ltd.	31

Copper, Lead and Rubber Prices.—Messrs. F. Smith and Co. report, April 20th: Copper (electrolytic) bars, £65 5s., 15s. inc.; ditto ditto sheets, no change; ditto ditto wire rods, £75 5s., 15s. inc.; ditto ditto h.c. wire, 9 7/16d., 1/16d. inc.

Messrs. James & Shakespeare report, April 20th: No change in the prices for copper bars (best selected), sheet and rod; English pig lead, £29 10s., £1 dec.

Messrs. Edward Till & Co. report, April 20th: India-rubber, Para fine, 1s. 11d., 2d. dec.

Our Foreign Trade.—March Figures.—The following were the values of imports and exports of electrical goods and machinery during March, 1926:—

	March, 1926.	Inc. or dec.	3 months, 1926.
Imports—			
Electrical goods and apparatus	287,955	− 44,790	−217,324
Machinery	1,264,400	+188,941	+251,683
(Electrical machinery)	117,155	− 10,854	− 10,384
Exports—			
Electrical goods and apparatus	994,854	+ 80,562	−161,530
Machinery	4,317,449	− 35,136	− 89,500
(Electrical machinery)	484,413	− 490	+ 8,322
Re-exports—			
Electrical goods and apparatus	20,560	+ 5,627	− 16,135
Machinery	121,078	− 2,212	+ 749
(Electrical machinery)	11,758	+ 6,616	+ 7,030

Lighting and Power Notes.

Ayrshire.—Electricity Supply.—The Electricity Board is considering the question of a supply of electricity to Maybole and Turnberry.

Bath.—Loans.—The Town Council has received sanction to a loan of £8,500 in respect of excess expenditure on mains and services, and £15,000 for new works. A further loan of £5,000 for expenditure on sub-stations for the next two years has been applied for.

Bolton.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £75,000 for mains in connection with the Corporation's electricity undertaking.

Brookwood (Surrey).—Electricity Supply.—A supply of electricity will shortly be available in Brookwood and Pirbright from the power station of the Woking Electric Supply Co., Ltd. The charges will be as follows:—Lighting, 7d. per kWh. Heating: Winter quarters, 3d. per kWh; summer quarters, 1½d. per kWh. Cooking: Winter quarters, 2½d. per kWh; summer quarters, 1½d. per kWh.

Burton-on-Trent.—New Plant.—At a recent meeting of the Town Council, the chairman of the Electricity Committee said the Committee had had under consideration the best method to adopt to make its generating station safe for the next two or three years, having regard to the Electricity Bill at present before Parliament. After careful consideration it was decided to increase the capacity of the plant by from 4,000 to 5,000 kW. When this extension was complete, the Corporation would have a stand-by in the old machine in case of a breakdown of one of the bigger machines. The cost would be approximately £30,000. A further extension of the system in South Derbyshire, which had been already sanctioned by the Council, would cost approximately £20,707. It was decided that application be made for permission to borrow the necessary money.

Carlisle.—Electricity Extensions.—The Town Council has decided to carry out mains extensions at a cost of £5,641. The electrical engineer is to prepare a definite scheme with a view to an application being made for an Order authorising the Council to extend its area of supply.

Cleobury Mortimer.—Electricity Supply.—The Rural District Council has given its consent to the erection of overhead wires by the Shropshire, Worcestershire, and Staffordshire Electric Power Co. for the supply of electricity to the town. The company will supply at from 7d. to 8d. per kWh for lighting, and at about 1½d. per kWh for power, heating, and cooking.

Continental.—France.—The Société de Transport d'Energie Electrique du Nord, in conjunction with the Société Electricité et Gas du Nord, is engaged in a considerable extension of the electricity supply service in the war-devastated area of the country. At Jeumont a new 7,500-kVA, 10,000/45,000-V transformer is being installed; three similar sets are being added to the sub-station of Fourmies, two of which will replace 2 500-kVA sets that are to be transferred to Cambrai and Bavay; two similar sets are being added to the trans-

former station at Hirson, while at Bavay a new sub-station is being erected which will be equipped with two 15,000/45,000-V transformers—one of 2,500 kVA from the Fourmies station, and one of 1,400 kVA from the Cambrai station.

The Société des Forces Motrices de la Selune, of Avranches, has recently secured a concession to establish a 30,000-V transmission line between Pontaubault (Manches) and Sainte-Brice-en Coglis (Ile-et-Vilaine) with the object of affording a supply of electricity to a large number of rural communes in that area.

East Ham.—ELECTRICITY SUPPLY.—The Electricity Committee has decided to lay a cable in connection with a supply of electricity to Manor Park, at an estimated cost of £2,000.

Edinburgh.—INQUIRY.—The Commissioners under the Private Legislation (Scotland) Act recently held an inquiry into a draft provisional Order promoted by the Corporation for general powers. The chairman asked that the clause to enable the Corporation to carry forward surpluses and deficiencies on the electricity undertaking should be specially considered. The Minister of Transport did not agree that deficiencies should be allowed to be carried forward. The Corporation thought that in certain cases it might be desirable to carry forward a deficiency, particularly when by so doing charges for electricity might be kept uniform. The Commissioners having considered the point, intimated that they desired to give effect to the suggestions of the Minister of Transport. In view of this decision, it was stated that the clause would be withdrawn by the Corporation.

Fowey.—ELECTRICITY SCHEME.—It was reported at a recent meeting of the Town Council that the St. Austell and District Electric Light & Power Co., Ltd., is shortly to commence laying an underground cable through the town in connection with the electricity scheme.

Fylde.—ELECTRICITY SUPPLY.—At a recent meeting of the Rural District Council it was decided that at the next meeting of the Council a resolution should be passed agreeing to Blackpool Corporation giving a supply of electricity to the townships of Marton and Carleton.

Glasgow.—ELECTRICITY IN SMALL HOUSES.—In connection with the scheme for laying mains to Possil housing estate, the electrical engineer recommends acceptance of similar charges to those made by the Gas Department for gas mains, namely, £5 15s. 8d. per house.

Hamilton.—HYDRO-ELECTRIC SCHEME POSTPONED.—In connection with the proposed hydro-electric installation at Clyde Bridge, the Corporation Electric Lighting Committee reports that it has considered the offers received for the scheme, the lowest being £38,949. The view of the Committee and of the resident engineer (Mr. Cooper) is that the project is sound from an engineering point of view, but meanwhile, owing to the large increase in the capital costs, it is not economical. The Town Council has agreed to wait until the effect of the Government's scheme for the supply and regulation of electricity has been ascertained.

Haworth.—INAUGURATION OF SUPPLY.—The electricity supply for the district was formally inaugurated by the chairman of the Urban District Council on April 10th. Electricity is obtained from Keighley in bulk at a pressure of 6,600 V, and is reduced at the sub-station for distribution. The cost of the scheme was approximately £6,000. Mr. Maxwell Webber is electrical engineer to the Council.

Hitchin.—INQUIRY.—The Ministry of Transport, on April 7th, held an inquiry into the application of the North Metropolitan Electric Power Supply Co. to erect an overhead line in the urban area for the transmission of electricity. The Urban District Council had refused its consent. For the company it was stated that it was desired to have a trunk line from Stevenage to Hitchin, and the Hitchin Rural District Council had given its consent. It was pointed out that the cost of an overhead line was £1,700 per mile, compared with £3,200 for underground mains.

Irish Free State.—THE SHANNON SCHEME.—The Free State Government hopes to have the Shannon hydro-electric scheme completed in 1929. The estimates for the current year show that the cost of the scheme, as originally calculated, will be £5,250,000, and that, with the new advance in the 1926-7 figures, £2,282,200 will have been provided, leaving nearly £3,000,000 to be found in 1927-8.

Japan.—ELECTRICAL DEVELOPMENT.—The I.G.R. is erecting a large steam power station near Teurumi, at a cost of 17,000,000 yen, and it will be completed by the fiscal year 1928-1929. The plant will include three 20,000-kW turbo-generators.

KOBE.—The city of Kobé has a plan to extend its electrical plant at a cost of more than ten million yen. The fund will be raised by loans issued subject to the authorisation of the Tokio Government. The plant will include a 35,000-kW set.

London.—ST. PANCRAS.—The Electricity Committee has had under consideration the revision of the charges under its scheme for electricity supply to small dwellings, and has recommended to the Borough Council that the fixed weekly charge be withdrawn and meters installed, electricity being charged at 7d. per kWh for a minimum consumption, according to the number of points per house, after which the present flat rate for lighting would apply.

ISLINGTON.—The Electricity Committee has voted capital expenditure as follows:—Cables, £9,000; services, £6,000; transformers, £3,500; meters, £3,000.

Loughborough.—ELECTRICITY EXTENSION.—The electrical engineer has recommended to the Electricity Committee that the cables be extended to the Outwoods Drive district and a sub-station erected at an estimated cost of £3,450.

Motherwell.—ELECTRICITY SUPPLY.—The Electricity Committee has accepted the offer of the Motherwell Machinery and Scrap Co., Ltd., to purchase and remove plant at the electricity works for £4,180. The Electricity Commissioners have written the Town Council requesting further information regarding the Council's application for consent to borrow £32,608 for a bulk supply.

Newcastle-on-Tyne.—PROPOSED CHANGE-OVER.—The Newcastle and District Electric Lighting Co., Ltd., has applied to the Corporation Transport and Electricity Committee for approval to change its system of supply to consumers in the city who are now being supplied from its single-phase, 80-cycle system at 100 and 240 V, and to substitute either its a.c. 250-V and 480-V, 3-phase, 40-cycle supply or d.c. at 240-V and 480-V. The Committee has recommended to the Town Council that the change-over be approved.

Northern Ireland.—LURGAN (CO. ARMAGH).—The Urban District Council is applying to the Electricity Commissioners of Northern Ireland for sanction to a loan of £11,350 in connection with its electricity scheme.

Nuneaton.—SCHEME APPROVED.—The Rural District Council has given approval to the proposals of the Leicestershire and Warwickshire Electric Power Co. to erect overhead cables between Long Lawford and the power station at Hinckley, passing through the parishes of Wolvey and Burton Hastings.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

SLEAFORD.—Lighting, heating, and power: A reduction of 1d. per kWh.

BOURNEMOUTH.—*Bournemouth and Poole Electricity Supply Co., Ltd.*—Lighting: First 5,000 kWh, per annum, 7d. per kWh; next 15,000 kWh, 6d.; beyond, 3½d. per kWh. Power: Varying from 3d. for the first 2,000 kWh per quarter to 1½d. for over 10,000 kWh. Heating and cooking: First 5,000 kWh per quarter, 2d. per kWh; beyond, 1½d. per kWh.

BLACKPOOL.—Heating: From 1¼d. to 1½d. per kWh; "all in" tariff, secondary charge, from 1d. to ¾d. per kWh; and an industrial heating tariff of 1½d. during peak load hours and ¾d. off peak load hours, subject to a minimum consumption of 2,000 kWh per quarter, with a meter rental of 10s. per quarter for two-rate meters.

SALFORD.—Power (within the borough): Varying from 2¼d. per kWh for the first 250 kWh per quarter, to .8d. per kWh for all energy in excess of 25,000 kWh, with an alternative charge on the maximum demand system. Power (in the urban district of Prestwich): Varying from 2¼d. per kWh for the first 250 kWh per quarter to .9d. for all energy consumed in excess of 25,000 kWh.

SOUTH SHIELDS.—Power, heating, and traction: From 1¼d. to 1¾d. per kWh.

CARMARTHEN.—*Carmarthen Electric Supply Co., Ltd.*—Lighting: 8d. per kWh. Heating and cooking: Summer quarters, first 100 kWh, 2d. per kWh; above this amount, 1¼d. per kWh; winter quarters, first 100 kWh, 2¼d. per kWh; above 100 kWh, 2d. Power: Sliding scale, from 4d. to 1¾d. per kWh.

HAMILTON.—Lighting: From 8d. to 6¼d. per kWh. Heating: From 2d. to 1¾d. per kWh, with reductions for public lighting and power.

RATHMINES AND RATHGAR (CO. DUBLIN).—Lighting: 6d. per kWh. Outside lighting: 4d. per kWh. Heating, cooking, and other domestic purposes: 2d. per kWh. Lighting (through slot meter, including meter rent): 7d. per kWh. Power: Unrestricted supply, 2d. per kWh; restricted hour supply, 1¾d. per kWh.

PEMBROKE (DUBLIN).—Lighting: From 6d. to 5¼d. per kWh. Heating and cooking: From 2¼d. to 1¼d. per kWh.

SALE.—Maximum demand system: 7d. per kWh up to 100 hours' use per quarter and 2d. per kWh beyond. Domestic heating: First 100 kWh per quarter, 2d. per kWh; next 100 kWh, 1¾d.; beyond, 1¼d. Private house domestic rate: A fixed charge of 20 per cent., of the rateable value, plus 1¼d. per kWh during the summer quarters, and ¾d. per kWh during the winter quarters.

Rothesay.—NEW POWER STATION.—Application has been made for consent to the establishment of a generating station at a cost of £10,200. Meanwhile the town is taking a supply of energy in bulk from the Rothesay Tramways Co., Ltd.

Sandwich.—ELECTRICITY SUPPLY.—The Town Council has appointed a committee to approach Messrs. Pearson and Dorman Long, Ltd., with a view to obtaining a supply of electricity for the borough.

Sheffield.—LOANS SANCTIONED.—The Corporation has received sanction to the borrowing of £300,000 for mains and £60,000 for equipment of sub-stations on consumers' premises.

Shrewsbury.—Loan Sanctioned.—The Electricity Committee has received sanction to the borrowing of £8,000 for plant.

Special Orders.—Applications have been made to the Electricity Commissioners for Special Orders by the following authorities:—The National Electric Construction Co., Ltd., for the supply of electricity in the urban district of Holbeach; the Derbyshire and Nottinghamshire Electric Power Co., to supply in the urban districts of Bakewell, Baslow and Bubnell, and South Darley, and the rural district of Bakewell; and the Truro Electricity Supply Co., Ltd., in the city of Truro.

Stourport.—New Power Station.—The new power station erected by the Shropshire, Worcestershire, and Staffordshire Electric Power Co. will, it is expected, be inaugurated in May by the Prime Minister. The plant may ultimately reach 200,000 h.p., and the area to be supplied will include the northern and central parts of Worcestershire and parts of Staffordshire and Shropshire. There will be sub-stations at Kidderminster, Halesowen, and Redditch, and a linking-up with the system in Smethwick, Dudley, and Oldbury.

Thornton-de-Fylde. — Loan Sanctioned. — Sanction has been received by the Urban District Council to the borrowing of £29,750 in connection with the electricity scheme for the district.

Torquay.—Loans Sanctioned.—The Town Council has received sanction to a loan of £10,000 for mains and services.

Extension of Supply.—Application has been made for a Special Order to extend the present area of supply so as to include a number of additional parishes. The total estimated capital cost of the extension is £21,800.

Wirral.—Electricity Scheme.—The Rural District Council, acting upon the advice of the Electricity Commissioners, has decided to negotiate with the Corporations of Birkenhead and Wallasey, and the Mersey Power Co., Ellesmere Port, with a view to obtaining bulk supplies of electricity, to carry into effect the Council's electricity scheme for which it obtained a draft Order in August, 1925. The Commissioners, following a recent inquiry into an application for sanction to borrow £110,000 to carry out the first part of the Wirral Council's scheme, expressed the view that a modified scheme should be brought forward.

Worcester.—Loan.—The Electricity Committee has recommended the City Council to apply for sanction to borrow £30,000 for the following purposes:—Mains, £15,000; services, £6,500; and sub-station equipment, £7,500.

Tramway and Railway Notes.

Canada.—New Electric Railway.—The Ontario Hydro-Electric Commission is conferring with the municipalities concerned in connection with a proposal to construct a high-speed radial railway from Toronto to Hamilton at a cost of $11,000,000.

Continental.—Germany.—It is reported that the German State Railway authorities have decided to establish a new power station near Berlin to supply electricity for the Berlin Metropolitan Railway. A feature of the new plant which is to be located near the Berlin municipal power station at Rummelsberg, is that the boilers will be adapted to use as fuel lignite drawn from the mines near Frankfürt-am-Oder, about 62 miles away.

The Baden State Railway Council is urging the German State Railway authorities to take in hand without further delay the electrification of the railway between Frankfürt-am-Main and Basle.

East Ham.—Track Renewals.—The Tramways Committee has decided to reconstruct the tramway track in Rowland Road West at an estimated cost of £15,500.

London.—A New Ticket Machine.—A new type of ticket-issuing machine is shortly to appear on the Underground Railways, which will fully print, number, and date the ticket at the time of issue at the rate of five per second.

Trafalgar Square Tube Improvements.—The new escalators at Trafalgar Square Station (Bakerloo) were put into service on April 13th. The new escalators are of comb type. The area now occupied by the lifts will be devoted to a new and more spacious booking hall. The station, now catering for four million passengers a year, will be able to handle eight millions with ease. A new subway, giving a connection between the Underground station and Cockspur Street, is to be constructed. This will be completed by about midsummer.

Royton.—Scheme Rejected.—In connection with a request from the Oldham Corporation for the consent of the Urban District Council to the reconstruction of the tramway track in Oldham Road between the boundary at Longsight and Royton Town Hall, the Council has decided that it cannot reconsider its decision not to proceed with the proposed work.

Worcester.—Purchase of Undertaking.—At a recent meeting of the City Council it was decided to purchase the tramway undertaking for £58,000. The necessary Bill will come before the House of Lords on April 27th.

Telegraph and Telephone Notes.

Argentina. — Telephone Repeaters. — An amplification station is about to be erected by the Argentine Telephone Co. in Buenos Aires to link up subscribers in the towns of Bahía Blanca and Córdoba, a total distance of 1,952 kilometres. Santa Fe, Villa María and Rio Cuarto will also be brought within the radius.—*Reuter's Trade Service* (Buenos Aires).

Guernsey.—Inter-Island Telephony.—In response to a petition from the tradespeople of Guernsey and Alderney to the State Telephone Council, experiments in telephony between the two islands have been successfully carried out. It has been found possible to use the single telegraph wire which already unites the two islands for carrying on a telephone conversation, and at the same time to send a telegraph message, which will obviate the necessity of laying a new cable.

South Africa.—Long-distance Telephony.—Direct telephone communication was inaugurated on April 12th between Johannesburg and Cape Town, a distance of 908 miles, five repeaters being used.

The Telephone Service.—Suggested Separation.—At its annual meeting this week the London Chamber of Commerce is to urge the Government to appoint at an early date a Commission for the purpose of introducing a new system of Post Office Administration, including the separation of the postal service from the telegraph and telephone services and possibly the vesting of the latter services in a semi-independent body, which should include non-official representation.

Continental Service.—All-day telephone communication between England and Germany will be established when the last portion of the cable connecting Domburg (Holland) with Aldeburgh (England) has been linked with the German telephone system. The German steamer *Neptune* went to Holland from Cologne last week to carry out this work, which is expected to be completed by the end of April. The cable is 165 kilometres long and weighs 1,700 tons.—*Reuter* (Berlin).

New Exchanges.—To meet the immediate requirements of the "Hop" district a new 800-line exchange was opened on April 19th and will be known as "Waterloo." During the summer two others, to be called "Rodney" and "Reliance," will be opened to serve the Walworth and Oval areas respectively; they will have a capacity of 3,500 lines each. A new Bermondsey exchange is also in hand.

Police Telephone Boxes.—It is estimated that £13,000 a year will be saved to the rates of Newcastle by the decision of the Watch Committee to introduce the police telephone box system. The nine police stations at present in use will be reduced to three, and in the place of the six stations to be closed, fifty-one telephone boxes will be erected.

Northern Trunk Extension.—The trunk telephone extension from Inverness and Tain, northwards to Wick and Thurso, was formally opened last week. The extension covers a distance of 118 miles, and Mr. John McAllan, chief inspector of telegraphs, Inverness, was responsible for the carrying out of the work.

The Yap Cable.—Dutch Assignment.—According to German reports, the Allied Governments contemplate the assignment of the Yap-Menado cable, which belonged to the German-Netherlands Telegraph Co. and was seized during the time of the war, to the Dutch Government. When the negotiations on the matter have been concluded it will be possible for the financial situation of the Company to be cleared up in connection with the claims made by the Company on the German Government for compensation.

Radio Notes.

Licences.—Prosecutions.—It was announced on April 16th that proceedings had been taken in 135 cases against people for installing broadcast radio receiving sets without licences, and that 134 convictions had been secured.

Korea.—Broadcasting Service.—The Seoul Radio Broadcasting Station Establishment Committee hopes to open a station in July and establish a service with a capital of y. 200,000; 48 of the promoters of the scheme are in Seoul and 51 in the provinces. Monthly reception charges are estimated at y. 2, the number of possible subscribers being expected to reach 5,000. The undertaking is to be a corporate juridical body, and *Eastern Engineering* expects the projected station to be powerful enough to serve the whole of Korea. Broadcasting will be in both Korean and Japanese.

United States.—"Radio Slander."—The first conviction in America for "slander" by wireless has been recorded. *The Times* explains that recently a wireless news "bulletin" was broadcast from Chicago's "Moulin Rouge" cabaret, which contained a statement regarding the State Attorney, Mr. Crowe. The Attorney issued a writ for libel, but this was later reduced to a slander charge, and the proprietor of the establishment has been ordered by the courts to pay a fine of £5 and costs for "disorderly conduct."

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Australia.—MELBOURNE.—June 16th. City Council. Turbo-alternator, exciter, and condensing plant.*

Adwick-le-Street.—May 19th. Urban District Council. H.p. switchgear and cables, step-down transformers, l.p. distribution gear, pillars, cables, joint boxes, &c. (April 16th.)

Barking.—May 10th. County of London Electric Supply Co., Ltd. Coal-unloading, storing, and reclaiming plant. (April 9th.)
May 11th. Switchgear and accessories, transformers, and piping equipment. (March 26th.)

Chile.—SANTIAGO.—August 20th. Chilean State Railways. Signals, telegraphs and telephones, electrical material for sub-stations, aerial lines, and lighting.*

Croydon.—April 28th. Electricity Department. Water-softening plant. (See this issue.)

Doncaster.—May 4th. Electricity Department. One 1,000-kW motor converter and l.p. switchgear. (See this issue.)

Dublin.—May 4th. Electricity and Public Lighting Department. E.h.p. and l.p. cables, cast-iron pillars, and stoneware troughing, section pillars, compound and other materials and accessories for one or two years. (See this issue.)

Dundee.—Education Authority. Installation of electric lighting at four schools. Specifications, &c., from Mr. John E. Williams, executive officer.

Edinburgh.—April 26th. Electricity Supply Committee. Installation of electric lighting and wiring for motors at the public wash-house, Portobello. Specifications from the Engineer's office, Dewar Place.

Exeter.—May 11th. Electricity Department. Boiler-house plant complete:—Two water-tube boilers with economisers, pumps, coal bunkers, conveyor, and accessories. Self-supporting steel chimney, induced-draught fan, and accessories. (April 9th.)

Glasgow.—May 6th. Electricity Department. L.p. cables, small i.r. insulated cables and flexibles, meters and carbons for 12 months. (See this issue.)

Grimsby.—April 26th. Electricity Department. E.h.p. cell-type switchgear. (April 16th.)

Halifax.—Wiring for about 70 points in house. Electricians desirous of tendering to send names to Henry Thompson, architect, Elland.

Harrogate.—April 25th. Electricity Department. H.p. and l.p. switchgear for sub-stations. (April 9th.)

India.—April 30th. India Store Department. 22,000-V cables. (April 2nd.)
April 30th. Alkaline train-lighting cells. (April 16th.)
May 7th. 15 motor-coach underframes and bodies, 30 motor bogie trucks. (March 12th.)
May 11th. One 200-kW La Cour-type motor converter. (See this issue.)
May 14th. Three 5-kW oil engine-driven generator sets, one switchboard, and two pumping sets.*
May 15th. Madras and Southern Mahratta Railway Co., Ltd. Telephone line material (comprising porcelain insulators, galvanised terminal irons, &c.), copper line wire (1,302 miles), copper binders, tapes, &c. (See this issue.)

London.—LONDON COUNTY COUNCIL.—May 4th. Electric wiring and fittings at the Alton Street elementary school, Poplar, E. (April 16th.)
H.M. OFFICE OF WORKS.—April 28th. Fuse boards and switches. (April 16th.)
May 7th. Steel conduits and fittings for electric wiring. (See this issue.)
ST. MARYLEBONE.—May 5th. Electricity Department. L.p. and e.h.p. underground cables for 12 months. (See this issue.)

Manchester.—May 11th. Tramways Committee. Electric tramcar bodies, trucks, motors, and controllers. Specifications from Mr. H. Mattinson, general manager and chief engineer, 55, Piccadilly, Manchester.
April 30th. Central Purchasing Committee. Twelve months' supply of incandescent lamps. Forms of tender from Mr. H. C. Lamb, manager, Electricity Department, Manchester.

Meltham.—April 27th. Electricians' work at extension of Liberal Club. Quantities from Stocks, Sykes & Hickson, architects, 4, St. Peter's Street, Huddersfield.

New Zealand.—June 21st. Auckland Electric Power Board. L.p. insulators, &c.*
WELLINGTON.—May 12th. Post and Telegraph Department. 18 switchboards.*
DUNEDIN.—May 28th. Otago Harbour Board. One portable electrically-driven cargo stacker.*

Nottingham.—May 31st. Board of Guardians. One 60-kW d.c. turbo-generator, &c., and alterations to main switchboard, &c. (April 16th.)

Seaham Harbour.—May 5th.—Urban District Council. Overhead l.p. pole line, h.p. cables, sub-station equipment, h.p. switchgear. Specifications (£2 2s.) from Mr. J. E. Favell, consulting engineer, 22, Oxford Street, Newcastle-on-Tyne.

South Africa.—JOHANNESBURG.—Municipal Council. 8 miles h.p. cable, 41 miles l.p. cable.*

Southern Rhodesia.—June 21st. Department of Posts and Telegraphs. Automatic telegraphs. Automatic telephone exchange for Salisbury. (See this issue.)

Spain.—MADRID.—May 9th. Compania de los Caminos de Hierro del Norte. Overhead line, converting sub-stations, locomotives and motor coaches for the electrification of the lines from Barcelona to Manresa and San Juan de las Abadesas in one contract. The constructors are to obtain as much as possible of their supplies from Spanish industries.

Switzerland.—Tenders have been invited for the erection of the overhead lines necessary for the electrification of the railway between Brugg and Pratteln.

Turkey.—May 15th. Direction Générale des Postes et Télégraphes. 111,000 metres of 3, 7, 10 and 12 pair aerial telephone cable; 10,000 metres of 3, 7, 10 and 12 pair underground cable with joint boxes and accessories.*

Walthamstow.—May 12th. Electricity Department. One 1,500-kW motor converter. (See this issue.)

Warrington.—April 26th. Electricity and Tramways Committee. L.p. paper and lead-covered cables. (April 9th.)
May 10th. Electricity Department. E.h.p. sub-station truck-type switchgear. (See this issue.)

Waterford.—May 12th. Electricity Department. Two 250-kVA, 3-phase alternators direct coupled to heavy oil engines, e.h.p. mains and l.p. underground distribution system, transformer kiosks, pillars, street lighting services, l.p. overhead distribution system, &c. (April 9th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Barnes.—Lighting Committee. Accepted:—
Feeder pillars.—W. Lucy & Co., Ltd.

Bath.—Town Council. Accepted:—
7,000-kW Brush-Ljungström turbo-alternator, complete with condensing plant and accessories (£23,030).—Brush Electrical Engineering Co., Ltd.

Bradford.—Tramways Committee. Accepted:—
24 tramcar gear wheels (£164).—Alfred Wiseman, Ltd.

Burton-on-Trent.—Electricity Committee. Accepted:—
Switchgear for Park Street sub-station (£599).—Ferguson, Pailin & Co., Ltd.

Carlisle.—Electricity Committee. Accepted:—
Overhead line to Cocklakes (schedule prices).—British Insulated Cables, Ltd.

Croydon.—Electricity Committee. Recommended:—
Steam receiver and pipe work in connection with erection of alternator set (£1,365).—Babcock & Wilcox, Ltd.

Dublin. — City Administrative Commissioners. Accepted:—
Wiring 230 houses in connection with the Croydon Park housing scheme (£2,714), and 218 houses at Kehoe Square (£2,601).—Dublin City Electricity Department.

East Ham.—Electricity Committee. Recommended:—
Cable (£6,147).—Bergmann Electric Co., Ltd.
Conduit tiles (£11 9s. 6d. per 1,000).—J. Baldwin.
Three switchboard panels (£210).—Bertram Thomas.
Two feeder pillars (£117).—W. T. Henley's Telegraph Works Co., Ltd.
High-pressure cylinder (£1,230).—Murgrave & Co., Ltd.

The Council has since decided to refer to the Government the question of the contract for the supply of a new feeder cable for Manor Park. The lowest tender was that of the Bergmann Electric Co., Ltd., at £6,147, but there was considerable opposition to the acceptance of a tender from a Continental firm.

Grange-over-Sands (Lancashire).—District Council. Accepted:—
Underground electric cables and connections for the new electricity area (£2,740).—Johnson & Phillips, Ltd.

Gravesend.—Electricity Committee. Recommended:—
Steam pipes (£218 15s.).—Foster Bros.

Heywood.—Electricity and Tramways Committee. Accepted:—
Overhauling the e.h.p. overhead line between the electricity works and Bury.—British Insulated Cables, Ltd.

Leyton.—Education Committee. Accepted:—
Installing electric light at Sybourn Street Infant School (£205).—Burdette and Co.

London. — ISLINGTON. — Cleansing Committee. Recommended:—
Two 3½-ton electric vehicles (£1,892).—Electricars, Ltd.

Lamp Contracts.—Metro-Vick Supplies, Ltd., has received contracts from the London, Midland & Scottish Railway Co. for "Cosmos" vacuum train lamps, and from the Admiralty for "Cosmos" gasfilled ordinary lamps for H.M. ships.

Lynn.—According to the *Daily Telegraph*, the Town Council last week accepted a German tender for six miles of electrical cable, the price being £2,480, which was nearly £900 less than the lowest British tender.

Maxwelltown.—Town Council. Accepted:—
Wiring houses at Troqueerholm for electric light (A type, £47 10s.; B type, £25 16s.; C type, £25 10s.; D type, £25 10s.).—Mr. Moodycliffe.

New Zealand.—AUCKLAND.—Auckland Power Board. Accepted:—
Cable (£17,000 approx.).—Concordia Electric Wire Co., Ltd.

Oldham.—Electricity Committee. Accepted:—
Ventilating frames and covers.—John Hall (Oldham), Ltd.
Cable.—Union Cable Co., Ltd.
Switchgear.—Ferguson, Pailin, Ltd.

Perth.—Corporation. Accepted:—
Electric lighting installation at Corporation housing schemes at Pitbeavlis.—W. Borthwick.

Portsmouth.—Electricity Committee. Recommended:—
Two test panels (£376).—Johnson & Phillips, Ltd.
1,500-kVA transformer (£890), three transformers (£267).—Hackbridge Electric Construction Co., Ltd.

Ramsgate.—Town Council. Accepted:—
Installing electric light at the Westcliff Concert Hall (£216).—E. A. Pinto.

Rotherham.—Corporation.
Straker-Clough omnibus chassis.—Clough, Smith & Co., Ltd.

Sheffield.—Tramways Committee. Recommended:—
500 steel tramcar tires (£2,644).—John Brown & Co., Ltd.

Stirlingshire.—Education Committee. Accepted:—
Installing electric lighting at new schools at Riverside, Stirling.—Lockhart & M'Nab.

Stoke-on-Trent.—Electricity Committee. Accepted:—
Dismantling interior of cooling tanks at central power house (£542).—Davenport Engineering Co., Ltd.
L.p. d.c. feeder panel at Burslem sub-works (£137).—Park Royal Engineering Co., Ltd.

Wakefield.—Housing Committee. Accepted:—
Wiring 50 houses on the Lupset estate.—Mr. H. Smith.

Forthcoming Events.

Birmingham Electric Club.—Friday, April 23rd. At the Grand Hotel, Colmore Row. At 7 p.m. Discussion of the I.E.E. Wiring Rules, to be opened by Mr. C. G. McDonald and Mr. H. Joseph.

Junior Institution of Engineers.—Tuesday, April 27th. At the Monico Restaurant, Piccadilly Circus, W. At 6.30 for 7 p.m. Annual dinner.

Institution of Electrical Engineers.—Thursday, April 29th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "The Frequency Characteristics of Telephone Systems and Audio-Frequency Apparatus and their Measurement," by Messrs. B. S. Cohen, A. J. Aldridge, and W. West.

(North-Eastern Centre).—Monday, April 26th. At Armstrong College, Newcastle-on-Tyne. At 7 p.m. Annual general meeting. Lecture on "Modern Methods of Measurement," by Mr. B. A. Robinson.

(Scottish Centre and Dundee Sub-Centre).—Friday, April 30th. At the Y.M.C.A. Hall, Constitution Road, Dundee. At 7.30. p.m. Lecture on "The Past, Present, and Future of Wireless Telephony," by Capt. P. P. Eckersley.
Saturday, May 1st. Excursion to St. Andrews.

(South-Midland Centre).—Monday, April 26th. At the University, Birmingham. At 7 p.m. Ordinary meeting.

(London Students' Section).—Wednesday, April 28th. At the E.L.M.A. Lighting Bureau, 15, Savoy Street, W.C. At 7 p.m. Lecture and demonstration on "The Art of Illumination."

Illuminating Engineering Society.—Thursday, April 29th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7 p.m. Discussion on "School Lighting (Modern Requirements and Recent Progress)," to be opened by Dr. J. Kerr.

Royal Institution.—Thursday, April 29th. At 21, Albemarle Street, W. At 5.15 p.m. Lecture on "The Imperfect Crystallisation of Common Things." by Sir W. Bragg.
Friday, April 30th. At 9 p.m. Lecture on "Wireless in the Empire," by Dr. W. H. Eccles.

Notes.

Local Societies.—Under the auspices of the Hastings and St. Leonards Radio Society, Mr. Wilfrid Schofield, of the Hart Accumulator Co., Ltd., delivered to an appreciative audience at Hastings on April 12th a lecture on "The Theory and Practice of Electric Accumulators."

NOTTINGHAM SOCIETY OF ENGINEERS.—A joint meeting with the Nottingham section of the Society of Chemical Industry was to be held on Wednesday last at the University College, when a paper on "Stream-line Filtration" was to be given by Professor J. W. Hinchley, A.R.C.S., F.I.C., accompanied by a demonstration of the stream-line filter.

A Large Hydro-Electric Project.—In a recent issue of *Power* some details are given of a scheme which has been submitted to the Chicago Chapter of the Izaak Walton League of America by Mr. C. Campbell, as a solution to the problem of maintaining and increasing the present low levels of the Great Lakes. The plan provides a new supply of water from the north into Lake Superior by diverting the waters of the watershed of the Albany River and its main tributary, the Ogoki, by the construction of two great dams, one on each side of the two rivers, and bringing these stored waters southward, through a canal cut through the high land on the southern side of this watershed, to flow from there south into Lake Nipigon and on through Nipigon River into Lake Superior. Mr. Campbell also suggests, as an after consideration, the creation of a new Great Lake, 15,000 sq. miles in area, should a great storage reservoir become desirable. The estimated cost of the scheme is $150,000,000, and the additional power which would be rendered available along the Great Lakes and the St. Lawrence River is estimated to be 1,000,000 h.p. A committee has been appointed to consider the merits of the schemes.

Iron Bauxite Smelting in Norway.—It is announced from Oslo that a large new works is to be established at Kinsarvik in Hardanger for the production of iron direct from the ore and the incidental output of alumina according to the process devised by Professor Pedersen, which is claimed to have been fully worked out. The scheme is being promoted by the A.S. Kinsarvik, in which the Aluminium Company of America has acquired or has applied to acquire the bulk of the capital. The process consists in the smelting of iron ore, but instead of limestone bauxite is used as a flux. The result is said to be the production of fine pure iron, equal to the best Swedish malleable iron, and of the semi-product alumina, which can be subsequently smelted in the electric furnace into aluminium. It is estimated that from 800 to 1,000 men will be permanently employed at the works and that from 500,000 to 600,000 tons of iron ore and bauxite will be required per annum.

Tramway and Light Railway Return.—A return has been issued by the Ministry of Transport of the accounts and statistical returns of the tramway and light-railway undertakings in Great Britain for the year ended December 31st, 1924, in the case of companies, and March 31st, 1925, for local authorities. It has been prepared and revised in accordance with the recommendations of a committee consisting of representatives of the Institute of Municipal Treasurers and Accountants, the Municipal Tramways Association, the Tramways and Light Railways Association, the Ministry of Health and the Ministry of Transport. The total route mileage open for traffic at the end of the period was 2,605 miles, of which 1,859 miles was worked by local authorities and 746 miles by companies. The total capital expenditure up to the same date amounted to £94,552,372. The total gross receipts for 1924-25 were £28,737,639, and the total working expenditure £22,733,155, leaving net receipts amounting to £6,004,484. The number of passenger journeys made during the year was 4,620,501,521, an increase of approximately 177 million over 1923-24. The car-miles run amounted to 378,239,229, of which 99.59 per cent. were by electric cars. The return, which is obtainable from H.M. Stationery Office, price 15s., also gives particulars of the trackless-trolley undertakings in Great Britain.

Telephotography.—Capt. R. H. Ranger, of the Radio Corporation of America, has brought a complete set of telephotography, or "photo-radio," apparatus to this country, and hopes, in co-operation with Marconi's Wireless Telegraphy Co., Ltd., to demonstrate during his visit to London the practicability of inaugurating a commercial service on his system. The route would be by land line to the Carnarvon radio station, thence across the Atlantic ocean to River Head, Long Island, and so by an 80-mile land line to New York. Three transmitters and two receivers are in use at New York City, and regular tests are being made with San Francisco; a limited service has also been opened between San Francisco and Honolulu. It is claimed that the detail in such pictures is comparable with that on an 80-line screen.

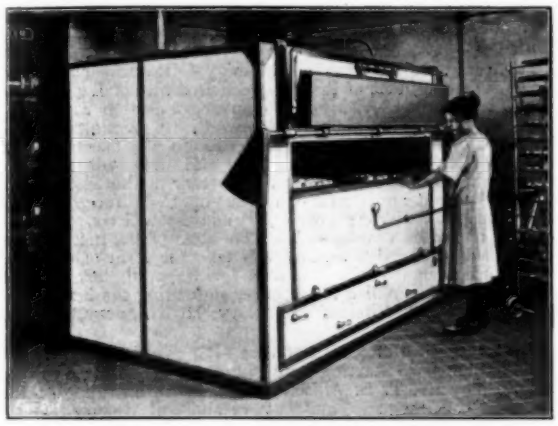
Telephone Battery-charging Set.—The Post Office Telephone Department has just taken delivery of a generating set, made by Messrs. Stuart Turner, Ltd., for battery-charging, which has an output of 1,200 watts. The telephone service does not require many sets of plant of as large a capacity as this, as a supply of electricity is generally available from the public mains. The plant is of the standard FS type made by the firm for country-house lighting, but the dynamo has been made capable of the special output necessary for telephone batteries.

Stage Lighting at the Plaza Theatre.—The electrical installation at London's latest kinema theatre, the Plaza, includes a bank of G.E.C. Schwabe horizon flood lamps, cloud apparatus, and panorama projectors for use in conjunction with an artificial horizon or cyclorama. This is probably the first installation of apparatus of this nature incorporating stage lighting in the general scheme which has been made in a kinema in the United Kingdom, and is of interest as a new departure in kinema equipment. Three G.E.C. magazine battens fitted with 150-watt "Osram" gasfilled lamps, wired on four-colour circuits, are also installed; these battens are of an entirely fresh design, and embody a new type of highly-efficient metallic reflector, rustless and non-tarnishing.

Explosive Reactions in Gaseous Media.—A general discussion on this subject is being organised by the Faraday Society, to take place on Thursday, May 13th, at the Institution of Mechanical Engineers, Westminster. The proceedings will be divided into two sessions. The first, from 2.30 to 6.30 p.m., will deal with the subject generally, and Professor H. B. Dixon, F.R.S., will preside. An introductory survey will be given by Dr. W. E. Garner, and papers initiating discussion will be presented by Professor Dixon, Professor W. T. David, Dr. S. W. Saunders, Dr. R. V. Wheeler, Professor W. A. Bone, and Dr. C. Campbell. The second session, 7.45 to 10 p.m., will deal with "Explosive Reactions Considered in Reference to Internal Combustion Engines." Sir Dugald Clerk, F.R.S., will preside and he will give an introductory survey, being followed by Professor David and Mr. H. T. Tizard. A dinner will be held between the sessions at the St. Ermin's Hotel. A full programme can be obtained on application to Mr. F. S. Spiers, 90, Great Russell Street, London, W.C.1.

Meter Engineers' Technical Association. — The first general meeting of the Association was held on April 15th at Anderton's Hotel, Fleet Street, London, E.C.4, when 37 members and visitors met to receive the Council's report on the progress made to date and to discuss proposed future activities. It was decided to hold the general meetings monthly during the winter months.

The Conveyor-type Electric Oven.—The use of the conveyor principle for electric ovens is proving of great assistance to progress towards the general adoption of electricity for baking. The outstanding advantages of this construction are greater convenience of operation and absolute uniformity of baking. Cumbersome drawplates and unwieldy peels are entirely dispensed with, since the oven brings its shelves right to the oven door for loading and unloading. Labour costs are thereby reduced and a valuable saving of space in front of the oven is effected. A one-sack conveyor oven, it is claimed, can easily be operated by a young girl. The accompanying illustration shows an oven of this type in operation in a bakery of Messrs. H Cookson & Sons, Preston, manufactured by the



An Electric Bakery Oven at Preston.

Metropolitan-Vickers Electrical Co. The conveyor oven is equally suitable for the mass production of one class of goods and for the mixed trade of the ordinary baker and confectioner. Provided that whatever goods are to be baked require the same temperature, they can be baked together and each portion removed when it is ready. It is interesting to note that ovens of this type have recently been installed for such well-known firms as Cadbury Brothers, the Indo-China Tea Company ("Kardomah" Cafés), and the Welwyn Garden City Bakery. Probably the deciding factor in connection with electric ovens is the question of the cost of operation and on this point there appears to be a good deal of misapprehension. The experience of those who have adopted electrical baking is that with electricity at 1d. per kWh, the cost is about 3d. per £1 worth of goods baked or 1¼ per cent. of the goods value.

Radium in Czecho-Slovakia.—During 1925, one and a half grammes of radium were produced at the Jáchymov mines, which raises the quantity of radium extracted since 1902 to about 12 grammes. A quantity (1.6 grammes) was lent some years ago to a British company, but this company having "disappeared," the radium was deposited at the Czecho-Slovak Legation in London. The rest, apart from quantities sold or placed at the disposal of clinics against an interest of 10 per cent. payable to the Ministry of Public Instruction, is deposited with the Office Bancaire against an interest of 10 per cent. The interest represents an important part of the revenue of the Jáchymov State mines. In 1922 the international price of radium was 10,000,000 crowns; now it is 3,000,000 crowns. The Jáchymov mines employ a staff of 300 workers, out of which thirty are miners; apart from the extraction of pitchblende and the production of radium, they are also engaged in the extraction of uranium compounds from which dyes are obtained for use in the glass and porcelain industries; the dyes are exported principally to Germany and Great Britain.—*Reuter's Trade Service* (Prague).

Electrically-operated Swing Bridges.—The Great Western Railway is installing electric power for the operation of the swing bridge over the River Neath at Court Sart on the Rhondda-Swansea Bay Railway, to take the place of the existing hydraulic machinery.

The Sarsfield swing bridge, spanning the Shannon at Limerick, which was erected some two years ago by the Limerick Harbour Board, has recently been equipped for electrical operation by the Metropolitan-Vickers Electrical Co., Ltd. The bridge was formerly operated by manual labour.

American Electric Lamp Developments.—An estimate of the incandescent electric lamp business in the United States for 1925 indicates the sale of 280,000,000 lamps for home, office and factory lighting, representing an increase of 7¼ per cent. on the sales of the previous year. About 195,000,000 "Miniature" flashlight lamps were also sold during that period, a 3½ per cent. increase. A practical method of chemically frosting the inside surface of electric lamp bulbs is said to have been developed, which, it is claimed, results in a reduction of the absorption of light to less than 2 per cent. The production of the double-filament Mazda headlight lamp, with two 21-c.p. filaments, was the foremost achievement in the small lamp field. One filament, it is stated, throws a powerful beam far down the road and the other filament gives a beam depressed about 2½ degrees.

Notable Performance of a Starter Battery.—Miss Violette Cordery's Invicta motor-car, on which she recently set up four new world's records and four international class records on the Monza track, Milan, is fitted with Exide batteries. The average speed maintained for 15,000 miles was no less than 56 m.p.h.

According to the rules governing these records, if for any reason the car stops on any part of the track, the driver may not have any assistance in bringing it round to the replenishing depôt. Consequently, as it is not too easy for one person to push the car for perhaps two miles, the Invicta Co. decided, before making the above record-breaking attempt, to discover how far the starter battery would drive the car on top gear with the engine switched off and against compression—admittedly a rather brutal test. The Invicta Co. reports the result of this test as follows:—"A standard Invicta car was taken at random, and on a level road the engine was stopped and the car driven solely by the Exide starter batteries for one mile at a speed of about 3 m.p.h. At the end of a mile the voltmeter still showed over 12 volts, and it was estimated that the car could have been driven about two miles in all. The following morning the same Exide batteries, with no recharging, started the engine at once from cold.

Scientific Organisation in Belgium.—Following the International Congress on Scientific Organisation held in Brussels in September last, a movement has been started in that city to organise a Belgian National Committee of Scientific Organisation.

All-Electric Public Baths.—On April 17th, the new all-electric public baths at North Woolwich were officially opened by the Mayor of Woolwich, Councillor W. Baresoot, J.P. The water is heated on the Bastian electric water-heating system, the apparatus being supplied by Messrs. Bastian & Allen.

Electrically-Welded Railway Apparatus.—Some interesting particulars are given in the *Railway Review* of a locomotive tender tank which, with the exception of the safety appliances (grab handles) has been constructed throughout by arc welding. The tank was put into service in 1921 and since that time it has covered a distance of 201,563 miles and no defects have developed in the welding. The tank is made of ¼-in. plate and is 26 ft. long, 10 ft. wide and 5 ft. 2 in. high. It has a capacity for 8,000 gallons of water and 12 tons of coal. In the average tank of this capacity there are approximately 7,000 rivets of a total weight of 800 lb., and the number of holes punched in sheets, angles and T-braces would total approximately 15,800. A total of 39° lb. of welding rod was used in the new tank. In order to eliminate the water scoring and rusting prevalent in the riveted type of tank, the welding of the T-braces to the bottom and top of the tank was continuous in its entire width.

A Theatre Lighting Installation.—The accompanying illustration shows the effects of the lighting installation with which the Aldwych Theatre, London, has been equipped. The large glass fitting suspended from the centre of the auditorium roof consists of 194 separate panels, and is equipped internally with forty 20-W gasfilled lamps; it is encircled by eight five-way pendant fittings equipped with 30-W lamps. At the base eight similar lamps are enclosed in a large lustre-beaded bowl, which also supports a circular fitting carrying four 3-way pendants similarly illuminated. A

Electric Lighting at the Aldwych Theatre.

smaller circular fitting is installed on either side of the central unit carrying six lighting units, which are equipped with "White Osrams." Three tastefully-grouped 18-lamp circles illuminate the proscenium, and triple wall brackets with shades are used to illuminate the tier fronts and boxes. The stage lighting is effected by 40-W vacuum lamps. A ten-light fitting and two-light brackets are installed in the outer hall, six multiple-light brackets in the vestibule, eight similar brackets and two handsome standards in the grand saloon, and a 21-light fitting in the rotunda well. The whole of the lamps installed are of the Osram type.

Appointments Vacant. — Transmission-line engineer (£800), electrical machinery and transformer engineer (£500), structural engineer (£600), hydraulic engineer (£600), and five junior assistant engineers (£200), for the River Shannon hydro-electric development scheme; electrical engineer (£650 +) for the Burgh of Hamilton; general assistant engineer (£270) for the Basingstoke Corporation Electricity Department; scientific officer for research work (£250+) for the Royal Aircraft Establishment, South Farnborough; district assistant to the mains engineer (£421), for the City of Birmingham Electric Supply Department; charge engineer, for the Lancashire Electric Power Co.; assistant shift charge engineer, for St. Marylebone Borough Council Electricity Department. (See our advertisement pages to-day.)

The Association of Mining Electrical Engineers.—The annual general meeting of the South Wales Branch and the Western Sub-Branch of the above Association will be held at the Wellington Hotel, Brecon, on May 8th, when a visit will be paid to the constructional works of the Taf Fechan Water Board at Pontsticill. Members and friends will meet at the tramway depôt of the Merthyr Electric Traction and Light Co., Ltd., and proceed by motor coach to Pontsticill, thence to Brecon for tea and the meeting, returning to Merthyr.

Institution Notes.

Institution of Electrical Engineers.—Informal Meeting.—At the informal meeting on April 12th Mr. J. Coxon was in the chair when Captain P. P. Eckersley opened a discussion on "The Linking together of Wireless and Wire Communication Systems."

The Chairman announced that this was the last meeting of the Session, and stated that while the standard of the discussions had been fully maintained and the numbers attending had exceeded those of previous years, the Committee was anxious to see even larger attendances; and as the programme for next Session would be under consideration shortly, he invited members to write to the Secretary proposing subjects to be discussed, and to suggest improvements that would increase the popularity of the informal meetings.

Captain Eckersley, in his own truly informal way, then reviewed some of the applications of linked wire and wireless systems. Explaining the difficulties of the intermittent methods by simplex working and the first attempts at duplex transmission made by Captain Round, he said great difficulties arose from having large transmitting apparatus near the receiver. He described the handicaps in using land lines that had been designed for other purposes. He drew diagrams of the unique semi-automatic board at 2LO, which insured a continuous broadcast programme by rapid transfer to other lines, in the event of failure of a transmitting station. His conclusions were that the linking of wire and wireless systems was unavoidable, but however indispensable the wireless system must inevitably be, in its present stage of development he would never use wireless where a wire would serve.

Scottish Centre.—At the sixth annual meeting of the Scottish Centre of the Institution at Glasgow, the following officials were elected for the year:—Chairman, Mr. W. L. Winning; vice-chairmen, Mr. A. S. McWhirter and Mr. W. F. Mitchell; hon. secretary, Mr. Joseph Taylor; Edinburgh assistant hon. secretary, Mr. H. V. Henniker.

Gas and Electricity Undertakings.—With the concurrence of the Council of the Institution and of the National Gas Council, a joint committee has been set up with the following reference:—"To consider whether in the national interest an inquiry might advantageously be held into the possibility of closer co-operation between gas and electricity undertakings in promoting capital and fuel economy in the supply to the public of energy derived from coal," with the understanding that no reports or discussions of the committee are to be published without the consent of both Councils. The committee is constituted as follows:—Messrs. R. A. Chattock, J. S. Highfield, G. W. Partridge, C. B. Sparks, C.B.E., W. B. Woodhouse, nominated by the Council, I.E.E.; Messrs. D. Milne Watson, D.L., and W. Cash, F.C.A., Sir A. Duckham, K.C.B., Messrs. A. W. Smith and C. Wood, O.B.E., F.C.S., nominated by the National Gas Council.

Association of Mining Electrical Engineers.—The annual general meeting of the London Branch of the Association was to be held on Tuesday last at the Junior Institution of Engineers. After the formal business there was to be a lecture in the form of a kinematograph demonstration on the subject of coal screening, blending and crushing, with special reference to the belt conveyor, by Mr. F. H. F. Hampton.

Royal Society of Arts.—At the meeting to be held on Wednesday, May 5th, at 8 p.m., Mr. C. F. Elwell, B.A., will lecture on "Radio: Its Past, Present, and Future." Prof. W. H. Eccles, D.Sc., F.R.S., will preside. On the following Wednesday, May 12th, at 8 p.m., Mr. Warre S. Bradley will deal with "Industrial Welfare in Practice." Sir Robert A. Hadfield will preside.

Institute of Transport.—Congress.—The sixth Congress of the Institute will be held at Birmingham from May 13th to 15th, and the proceedings will comprise the reading and discussion of papers and various visits and inspections. The latter will include the works of Messrs. Cadbury Bros., Ltd., at Bournville, the Kyotts Lake Depôt of the Birmingham Corporation Tramways, the Curzon Street goods station, L.M. and S.R., the carriage and wagon shops of the L.M. & S.R. at Derby, and the works of the Austin Motor Co., Ltd., at Longbridge.

Among the papers to be read are "Road Passenger Transport," by Mr. Alfred Baker, General Manager, Birmingham Corporation Tramways, and "Transport in England: a brief historical survey," by Mr. C. Grant Robertson, M.A., LL.D., C.V.O., Principal of the Birmingham University.

The Faraday Society.—The *Transactions* of this Society, which have hitherto appeared three times a year, will in future be published bi-monthly in order to expedite the publication of papers presented to the Society. In addition to the six bi-monthly parts, reports of two general discussions will be published annually, one in the spring and one in the autumn. The new arrangement begins with Volume XXII, 1926.

Institute of Wireless Technology.—Dinner.—Dr. Ralph Bown, vice-president of the American Institute of Radio Engineers, is at present visiting London in connection with developments in transoceanic radio telephony. A meeting of members of all classes of the Institute of Radio Engineers resident in Great Britain and the Irish Free State has been arranged to welcome Dr. Bown, who is the director of the Department of Development and Research of the American Telegraph and Telephone Co., of New York. His address will convey information regarding developments. The date of the meeting has been fixed for April 27th, and will take the form of a dinner at the Engineers' Club. Tickets (price 8s. 6d., exclusive of wine) should be applied for at once, addressing the hon. secretary, Institute of Wireless Technology, 71, Kingsway, London, W.C.2.

Junior Institution of Engineers.—In a paper on "Automobile Lighting, Starting and Ignition," read before the Institution, Mr. T. L. Allison described the operation of the trembler coil, magneto, and battery and coil systems of ignition, and mentioned the advantages of the battery and coil system in respect of cheapness, simplicity of moving parts, and adaptability and uniformity of spark at all speeds. He also described and illustrated several types of dynamos, starters, switchboards and wiring. Mr. Allison said that the public was very quick to condemn a car because of a known defect in its electrical equipment.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements).

At the last meeting of the Council of the E.C.A. Allied Associations, held at 15, Savoy Street, on April 13th and 14th, Mr. H. J. Miles, M.I.E.E. (Messrs. Page & Miles, Ltd., Brighton) was unanimously nominated as president for the year 1926-1927; and Mr. W. H. Walton (Messrs. Pinching and Walton) was also unanimously nominated as vice-president for the same period. At the same Council meeting Mr. L. C. Penwill was unanimously appointed as secretary of the E.C.A. Allied Associations. Mr. Penwill acted as assistant and deputy to the late Mr. Leonard G. Tate, M.I.E.E., for six years (from 1920), during which time he acquired an intimate knowledge of all the Association's affairs and activities.

The marriage took place at Fleetwood on April 3rd of Mr. Lawrence F. Rowntree, who is in charge of the local branch of the Humber Electrical Engineering Co., Ltd., and Miss Margaret E. Fish.

Mr. G. Weeks, of G. Weeks & Son, electrical engineers, Bromley, Kent, was on April 9th presented with a Gladstone bag, a cheque for 100 guineas, which he will devote to educational purposes, and an album containing an illuminated address, a portrait of himself, and a list of the subscribers, in recognition of his long and valued public services to the town. Mr. Weeks served on the Town Council from 1903 until his recent retirement, and filled the office of Mayor from 1911 to 1913.

Mr. W. J. Cooper, acting electrical engineer at Hamilton Electricity Works, has been appointed electrical engineer for the burgh of Hamilton.

The *Financial Times* states that Mr. F. Stacey Hooker, who in 1924 joined the board of C. A. Vandervell & Co., and also acted as general manager, has now resigned his executive position, but remains a director of the company. He is joining the board of several other companies.

The *Financial Times* says that Mr. Bruce has offered Mr. Howard Gepp, general manager of the Electrolytic Zinc Company, the chairmanship of the Migration Developmental Commission at a salary of £5,000 a year, and that Mr. Gepp has accepted the position.

Mr. L. Hermes, of the Marconiphone Co., Ltd., Tottenham Court Road, W.1, has resigned his post as sales manager of the company as from April 13th.

Aylesbury Town Council has increased the salary of the electrical engineer, Mr. W. A. Turnbull, from £650 to £750.

The Dover Town Council has increased the salary of Mr. Osborn, mains superintendent, from £409 per annum to £455.

Alderman J. W. Longley, consulting engineer and chairman of the Bradford Corporation Electricity Committee, is the newly-elected president of the Bradford Engineering Society.

On April 16th Mr. JOSEPH TAYLOR, foreman of the finishing department of English Electric Co., Ltd., at Preston, who is retiring after 27 years service, was presented with a cigarette cabinet, a silver cigarette case, and a silver matchbox. Mr. Barwick, works superintendent, made the presentation.

At a social gathering held on April 13th Mr. E. EVANS, who, after 30 years' service in the Electricity Department of the Southport Corporation, recently relinquished his position as works superintendent, was presented by the borough engineer, Mr. E. Moxon, on behalf of the members of the Welfare Club, with an easy chair and a framed photograph of the staff. Mr. Moxon, Mr. W. T. Gann, chief assistant engineer, and Mr. J. J. Young, works superintendent, each paid tribute to Mr. Evans's abilities.

Mr. W. A. MACKENZIE, of the Charing Cross Electricity Supply Co., was entertained to dinner at Gatti's Restaurant, Strand, on April 16th, and was presented with a token of esteem from his personal staff on the occasion of his appointment to the London Power Company.

M. MAURICE LE LAS, the president of the Société des Téléphones Le Las and a director of the Compagnie Française Amplion, of Paris, has recently been appointed a Chevalier of the French Legion of Honour. The Le Las Co. is well known as suppliers of telephone and signalling apparatus for the French Navy, and it is in connection with this work that the honour has been conferred on its president.

The Stoke Newington Electricity Committee has recommended that the sick leave of Mr. C. S. HANN, the borough electrical engineer, be extended until May 13th, as his medical adviser reports that there is every prospect of a permanent cure being effected.

MR. EDWARD PERUGINI recently resigned from the post of general manager of the Electrical Federation (Victoria) and, according to the *Australian Electrical Times*, Mr. W. RICHARDS, who has had an extensive experience in the Department of Trade and Customs, the Tariff Board, and in private business, has been appointed to succeed him.

We learn that a new air record for a flight from London to the Continent was set up this week, when Mr. P. F. BERK, chairman of Messrs. F. W. Berk & Co., Ltd., chemical manufacturers and makers of the B.A.A. accumulator acid, flew 1,200 miles in 15¼ hours.

Obituary.—MR. H. OPPENHEIMER.—Mr. Hermann Oppenheimer, whose death, in his seventieth year, was briefly mentioned in our last issue, was for many years one of the most

The Late Mr. H. Oppenheimer.

familiar personalities in electrical trade circles in London. His connection with the industry had extended over 40 years, for in the early days of the General Electric Co., Ltd., he was associated therein with Sir Hugo Hirst and the late Mr. Byng. After that relationship he became manager of the International Telephone Co., Ltd., first at Aldermanbury and later at Red Cross Street, London. Mr. Oppenheimer was always a man of spirit, energy and enterprise, and under his direction the International Co.'s business grew until it became necessary to move to more commodious quarters; it was then that he opened a new factory at Kilburn. During this period the telephone industry was undergoing rapid development and the company's work comprised telephonic installations in the Island of Guernsey and at Glasgow. Mr. Oppenheimer's principal achievement was the foundation in 1911 of the Phœnix Telephone & Electric Works, Ltd., of which he became chairman and managing director. At a dinner held to celebrate the removal of the company into the Hendon premises, marked testimony was borne to Mr. Oppenheimer's popularity. The group of well-known electrical men who used to meet at the Hotel Cecil and other places in the old days when the National Electrical Manufacturers' Association was beginning the discussion of problems confronting the electrical trader and manufacturer, will well recall the interest that Mr. Oppenheimer imparted to its proceedings, and they will also remember the important part that he played in bringing into being the Electrical Trades Benevolent Institution. In the ELECTRICAL REVIEW for June 2nd, 1905—nearly twenty-one years ago—the first annual meeting of the National Electrical Manufacturers' Association was reported, and it will perhaps be interesting to reproduce now the list of those who at that meeting were appointed as the committee, for they revive the surroundings in which Mr Oppenheimer was formerly a very familiar figure:—Messrs. Bevis, Grainger, Lundberg, Nalder, Northcote, Oppenheimer, Patersen, Clarke, and H. H. Berry. Those who knew him in these and other connections will agree that he was a lovable man, always optimistic, very good company, and interested in the electrical industry as a whole, and the employés of his company will bear testimony to the personal interest that he took in their well-being. Indeed, one of the schemes which he brought into existence shortly before his death was a pensions scheme, to which the company contributed handsomely.

MR. A. A. BROWN.—The death took place, on April 7th, at the age of 48 years, of Mr. Alfred Alexander Brown, who had for many years been in business as an electrician in Church Street, Barnsley.

MR. A. F. LOVEY.—We regret to record that the death took place, on April 10th, of Mr. Arthur Feri Lovey, of Blackheath, S.E., who had for 47 years been on the electrical staff of the Telegraph Construction and Maintenance Co., of East Greenwich. Since 1880 he had assisted in laying cables in many parts of the globe.

MR. H. A. OLIVE.—The death took place, on April 14th, in hospital in London, after an operation, of Mr. Henry Andrew Olive, who was in business as an electrical engineer at Sittingbourne. He was 40 years of age.

New Companies Registered.

Gravesend Welding & Electrical Engineering Works, Ltd. (213,118).—Private company. Registered April 12th. Capital, £1,500 in £1 shares. Objects:— To acquire the business of welders and electrical and general engineers now carried on by S. Lovett and E. J. S. Wheatcroft at Gravesend and Northfleet, Kent. The permanent directors are:—S. Lovett, 28, College Road, Northfleet; E. J. S. Wheatcroft, 4, Park Place, Milton Road, Gravesend; E. W. Whiteman, 2, Ivanhurst, Overcliffe, Gravesend. Qualification, 400 shares. Remuneration, £30 per annum, divided between them. Solicitors: Edward Lovell & Son, Gravesend.

County Electrical Co. (Pendleton), Ltd. (213,097).—Private company. Registered April 12th. Capital, £2,000 in £1 shares. Objects: To acquire the business of an electrician carried on by T. H. Blood as the "County Electrical Company," and to carry on the same and the business of electrical engineers and contractors, dealers in electrical and wireless goods, &c. The directors are:—H. T. Blood and Mrs. E. Blood, both of Ravensfleet, Linney Lane, Bramall, Cheshire. Qualification, 1 share. Remuneration as fixed by the company. Registered office: Town Hall Chambers, Broad Street, Pendleton, Manchester.

Dri-Ac, Ltd. (213,055).—Private company. Registered April 9th. Capital, £1,500 in £1 shares (1,300 ordinary and 300 deferred). Objects: To acquire from C. G. Smith the benefit of certain existing inventions relating to secondary cells or batteries for electricity storage, and the trade mark or name of "Dri-Ac" used in connection with the sale of apparatus, &c., and to carry on the business of electric or wireless apparatus engineers, &c. The subscribers (each with one ordinary share) are:—C. G. Smith, "Woodville," Oakland Avenue, Cheltenham, Glos., electrical engineer; J. E. Mindfino (?), Avening Court, Glos., gentleman. The directors are not named. Qualification: 10 shares. Solicitor: J. G. Fishwick, 5, Cook Street, Liverpool.

The Standard Sealing-Chamber Co., Ltd. (213,144).—Registered on April 13th as a company limited by guarantee and not having a capital divided into shares, with 20 members each liable for £10 in the event of winding up. The objects are:—To acquire, develop and turn to account patent No. 200,895, of 1923, for an invention relating to improvements in and relating to the connection of electric cables to electrical apparatus, and to carry on the business of electrical engineers and contractors, manufacturers of and dealers in electrical, magnetic, galvanic and other apparatus, &c. The management is vested in an executive committee of not less than three or more than 11 members. The first members are:—British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2; English Electric Co., Ltd., Queen's House, Kingsway, W.C.2; General Electric Co., Ltd., Magnet House, Kingsway, W.C.2; Edward Holme & Co., Ltd., Broadheath, Altrincham; Johnson and Phillips, Ltd., Charlton, S.E.7; Mavor & Coulson, Ltd., 47, Broad Street, Mile End, Glasgow; Metropolitan-Vickers Electrical Co., Ltd., 4, Central Buildings, Westminster, S.W.; Bruce Peebles & Co., Ltd., Edinburgh; Allen West & Co., Ltd., Lewes Road, Brighton, all electrical engineers. Secretary: J. Bilsland. Solicitor: T. Trimnell, 1, Lincoln's Inn Fields, W.C. Registered office: 57-58, Chancery Lane, W.C.2.

Crow, Davies & Co., Ltd. (213,086).—Private company. Registered April 10th. Capital, £500 in £1 shares. Objects: To carry on the business of electrical and mechanical engineers, &c. The directors are:—F. G. Crow, 14, Upper Hornsey Rise, N.19, engineer; E. W. Davies, 4, Martlett Chambers, Crown Court, Covent Garden, W.C. Qualification, 100 shares. Remuneration as fixed by the company. Secretary: I. M. Chapman. Solicitors: Bernard Shaffer & Co., 57, Conduit Street, W.1. Registered office: Buchanan Buildings, Holborn, W.C.

Globe's Auto Electrical Co., Ltd. (213,163).—Private company. Registered April 14th. Capital, £3,000 in £1 shares. Objects: To acquire the business of a magneto and general electrical engineer formerly carried on by Anna Globe at Broad Lane, Sheffield. The directors are:—H. Heath, 649-651, Attercliffe Road, Sheffield, motor car proprietor; F. Simpson, address not stated; Mrs. A. Globe, 37, Alexandra Road, Chesterfield. Solicitors: Chambers & Sons, 26, Bank Street, Sheffield.

Official Returns of Electrical Companies.

Lewes and District Electric Supply Co., Ltd.—Satisfaction in full on March 22nd, 1926, of debentures dated December 30th, 1910, securing £8,800.

Debenture dated March 23rd, 1926, to secure £20,000 and bonus, if any, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Prudential Assurance Co., Ltd.

Aldeburgh Electric Supply Co., Ltd.—Satisfaction in full on March 26th, 1926, of debenture dated February 9th, 1918, securing £2,500.

Shoreham and District Electric Lighting and Power Co., Ltd.—First mortgage debenture dated March 19th, 1926, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Solicitor to H.M. Treasury.

Lighting Trades, Ltd.—Two charges dated March 19th, 1926, to secure £55,000 and £35,000, respectively, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Nobel Industries, Ltd., and Curtis's & Harvey, Ltd., Nobel House, Buckingham Gate, S.W.1.

J. P. Hall & Co., Ltd.—Particulars filed of £46,666 13s. 4d. debentures authorised March 30th, 1926, constituting a specific charge on the company's freehold and leasehold property at Oldham, and a floating charge on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

"M.K." Electric, Ltd.—Particulars filed of £10,000 debentures authorised March 12th, 1926, charged on the company's undertaking and property, present and future, including uncalled capital, if any, the amount of the present issue being £4,000.

Cooke & Whitfield Wireless, Ltd.—E. P. Q. Carter, of 35, Waterloo Street, Birmingham, C.A., was appointed receiver and manager by order of Court dated March 30th, until April 13th, 1926, or until a further order.

Hayden, Ltd.—W. Reynolds, accountant, of 9, Heather Gardens, Golders Green, N.W.11, was appointed receiver and manager on March 22nd, 1926, under powers contained in debenture dated December 3rd, 1926.

G. W. M. Electrical Co., Ltd.—A. C. J. Jackson, of 43, Grafton Street, Tottenham Court Road, W.1, was appointed receiver and manager on April 7th, 1926, under powers contained in debentures dated December 24th, 1925

Maywood Engineering and Electrical Manufacturing Co., Ltd.—Mortgage or charge on the company's undertaking and property, present and future, including uncalled capital, dated March 25th, 1926, to secure £750. Holder: Lady Mills, Wentworth, Virginia Water.

Electric Construction Co., Ltd.—Satisfaction to the further extent of £3,700, on March 31st, 1926, of 4 per cent. perpetual first mortgage debenture stock secured by trust deed dated December 16th, 1897, securing £200,000.

City Notes.

Reports and Meetings of Electrical Companies, Dividend Results, &c.

Vickers, Ltd.

Mr. Douglas Vickers (president) occupied the chair at the annual meeting on April 15th and presented the report, which was dealt with in our last issue (p. 630). He said that the profits of the past year were sufficient to pay preference dividends and leave a margin of £18,275 to be carried forward. In the opinion of the directors it was not necessary to make any further reduction last year of the low value of assets recently taken as a basis upon the recommendation of the advisers, but considerable sums had been written off for depreciation in the accounts of the subsidiary companies. The board would probably decide to reorganise some of the other subsidiary companies to bring their capital down to a figure more in accordance with the value of their assets. Reviewing the activities of the subsidiaries during 1925, Mr. Vickers said that on the purely electrical side W. T. Glover and Co., Ltd., and the Metropolitan-Vickers Electrical Co., Ltd., had done well. The latter company had cultivated foreign business very carefully, with the result that considerably over half its orders came from abroad. Those foreign orders included some of the heaviest and most important pieces of machinery made in the country. After dealing with the prospects of the shipbuilding and armament departments, the president made reference to the Electricity Bill and said that the proposals had caused a setback in the demand for heavy generating plant. There would, however, soon be urgent necessity for new plant to meet the growing demand and to supersede the small inefficient stations which had stood so long in the way of development. He deprecated attempts to wreck the Bill and hoped that the Government would insist upon the provision of a "grid-iron" of mains for the interchange of energy between systems, and the construction of new stations to feed it. Apart from that there should be as little interference as possible with the generators and distributors of electricity. Mr. R. McKenna seconded the adoption of the report, which was carried. The whole of the directors were re-elected with the exception of Lord Invernairn, who had expressed a wish to retire.

Electric Supply Corporation, Ltd.

Mr. K. A. Scott-Moncrieff (chairman) presided at the annual meeting on April 15th, and in presenting the report (*vide* ELEC. REV., April 9th, p. 591), he said that although the energy supplied in Dumbarton and Hitchin had decreased, in all the other towns served by the company there had been progress. The result was an increase of £1,969 in the amount carried to net revenue account. The company had increased its interest in the Hendon Electric Supply Co., Ltd. The Dawlish and North Berwick Companies had not yet issued their reports. The undertaking of the latter company had been acquired by the North Berwick Town Council on March 31st last, and the distribution of its assets would give the company a considerable premium on its holding in the North Berwick undertaking. The Dumbarton Burgh & County Tramways Co. was suffering from severe outside omnibus competition. The E.S. Corporation had increased its holding of short-term notes in the company; these were secured upon the shares of the Dumbarton General Omnibus Co., which had been formed to meet the competition. Referring to the Government's Electricity Bill, the chairman said that although there were points in the measure which would affect the company adversely, it would be all to the good if the company could take bulk supplies instead of running small generating stations. In connection with such supplies, however, a difficulty arose where the undertaking was purchasable by a local authority within a comparatively short period which would not give the company time to write off the capital cost of the plant which had to be discarded. The Bill made provision for that in general terms. The Dalkeith undertaking was being purchased by the Town Council, but the Chelmsford Council had not exercised its option at the end of last year. The next purchase period would be in 1936. The company had thought it advisable to extend its operations into new fields. Accordingly, the Orders in respect of Alton, Hants., and Wellington, Somerset, were being acquired, and also that for Seaford and Newhaven when it was granted. The company had also obtained Orders in its own name for the supply in Hitchin and Exmouth, as the existing arrangements were unsatisfactory.

Oliver Pell, Control, Ltd.

Speaking at the annual meeting on April 8th, the chairman (Mr. C. Oliver) said that the profit enabled them to maintain the dividend of 10 per cent. upon both the ordinary and preference shares. The position of the company had also been strengthened by substantial allocations to depreciation and by increasing the amount carried forward. The company had been engaged on street-lighting contracts during the year employing the "Oliver" lamp. In the directors' opinion the arc lamp was superior to the gasfilled lamp for street lighting, and was sure to come into its own again. Their subsidiary, the Varley Magnet Co., had been busy during the year, as had their switch department, whose products were sold to the trade by Tok Switches, Ltd., in which company they held a controlling interest. They anticipated a great expansion in the sale of their switches, which were replacing American patterns, and to provide for this growth they were reorganising their works in all departments and providing further accommodation and facilities. They considered that the Government should extend a certain measure of protection to the industry, and were willing to fall in with Sir Field Beale's recent proposal that manufacturers should agree, in return for protection, not to advance their prices to the public.

The report and accounts were adopted.

Lanarkshire Tramways Co.

Owing to unrestricted motor-omnibus competition, the company sustained a loss of £9,848 during 1925, and to this has to be added interest charges amounting to £858. After crediting £3,183 brought forward and £5,663 from investments, a debit balance of £1,859 remains to be carried forward. In view of the heavy loss, it was necessary to reduce the wages of the staff, and this resulted in two strikes. Expenses have been reduced in all directions, but until some control is exercised over the motor-'bus services in the area, the financial results will continue to be unsatisfactory. A statement circulated with the report shows that the receipts per car mile fell from 16.86d. in 1924 to 9.57d. in 1925. In the last eleven years a total of £388,383 has been expended virtually in relief of the ratepayers, including £238,469 for road maintenance. The report records the death of two directors, Sir Bache Cunard, Bart., and Lord Carmichael, whose places have been taken by Mr. G. F. Pollock and Mr. A. Clements. Meeting: April 30th.

Bournemouth and Poole Electricity Supply Co., Ltd.

The annual meeting was held on April 15th. Mr. J. A. Hosker (chairman), who presided, said that the report showed continued progress. The expenses had been increased by heavier rates and taxes, but the increase in revenue more than balanced that. The total reserves were now £446,271, while the ordinary capital was £360,000. Mr. Hosker was of opinion that unless the Government's Electricity Bill were considerably amended it would fail to secure the development of the industry and lower generating and distributing costs. If the company could obtain a bulk supply at a lower rate than that at which it generated electricity, the opportunity would be seized. Conversely, the company would be glad to afford a bulk supply to other undertakers. He feared that there was a danger of bureaucratic control impeding progress. So far as the company's area was concerned it would appear that it was unlikely to be affected for many years.

Canadian Companies.

Canadian General Electric Co., Ltd.—The gross profits for the past year were $1,617,092 and the net profits $933,751, as compared with $578,473 in 1924. The same amount was allocated to depreciation ($600,000), but the interest charges were lower, owing to the redemption of outstanding debentures and notes; these charges have now been

entirely eliminated. The payment of dividends absorbed $553,541, leaving a surplus of $380,209, as against $66,246 in 1924. This surplus has been employed to write off the premium paid on the redemption of the debentures. The cash balance at the close of the year was $1,092,119, as compared with $816,420 at the end of 1924, and the value of investments has risen from $325,152 to $849,012.

Canadian Light and Power Co.—By an extraordinary resolution passed recently, 40 per cent. of the principal indebtedness, represented by 5 per cent. 40-year first mortgage sinking fund bonds, is to be converted into fully-paid, non-assessable shares of the common stock of the company at par.

West Kootenay Power and Light Co.—The gross earnings for 1925 were $1,041,125, as against $683,416 in 1924. After providing for interest, depreciation, renewals and dividends, a surplus of $5,238 remains, which is added to $11,374 brought forward. Last year's surplus was only $67.

Belgian Companies.

The *Compagnie de Tramways et Electricité* states that the net profits realised in 1925 amounted to 718,000 fr., allowing of the distribution of a rate of 15 fr. net per share.

The *Compagnie Générale de Railways et Electricité* reports an increase in net profits from 7,252,000 fr. in 1924 to 7,945,000 fr. last year. It is proposed to pay a dividend at the rate of 31.20 fr. net per ordinary share, as compared with 31.87 fr. in 1924.

The *Société Générale Belge d'Entreprises Electriques* reports that the net profits increased from 3,502,000 fr. in 1924 to 4,783,000 fr. last year, permitting of the payment of a dividend at the rate of 42.90 fr. net per share, as compared with 46.75 fr. in the previous year.

The *Ateliers de Constructions Electriques de Charleroi* records net profits of 7,159,000 fr. for 1925, as compared with 5,295,000 fr. in the preceding year. The rate of dividend is 15.60 fr. net per share, as contrasted with 12.75 fr. in the previous year.

German Companies.

The *Welter Electricity and Lifting Appliances Company*, Cologne, reports a total loss of 61,000 marks for the years 1924 and 1925, which is covered by an appropriation from the special reserve fund.

The *Concordia Electricity Company*, Dusseldorf, has declared a dividend at the rate of 5 per cent. for 1925.

The *Transradio Wireless Company*, of Berlin, recommends the payment of a dividend at the rate of 8 per cent. for 1925.

South Wales Power Co., Ltd.—Speaking at the annual meeting last week, Mr. W. Forster Brown, who presided in the absence through illness of the chairman (Mr. W. North Lewis), said that in spite of industrial depression in the district the company had continued to progress. The first stage of the large developments in hand was completed recently, and two 15,000-kW turbo-alternators were running on high-pressure steam. The power station at Treforest now supplied energy for 73,000 h.p. of motors in South Wales and Monmouthshire, and the demand upon it was steadily increasing. Mr. Brown said that, in common with many others, he viewed the Government's Electricity Bill with grave misgivings, and all necessary steps were being taken to safeguard the shareholders' interests.

Cork Electric Tramways and Lighting Co., Ltd.—Mr. A. R. Monks, presiding at the annual meeting on April 15th, said that the tramway results had been unsatisfactory, and there was a small loss on operating to which had to be added renewal and depreciation charges. Under pressure from the Ministry, they had reduced their fares in the autumn of 1924, and the financial results on the basis of the present fares would always be unsatisfactory. The reduction in the lighting and power revenue was partly due to the small falling off in the power demands and partly to the reduced power and heating tariffs.

Low Temperature Carbonisation, Ltd.—Steps are being taken to reduce the capital of the company from £1,275,000 to £162,150 10s. by cancelling 2s. 6d. per share on the "A" preference shares, 17s. 6d. on each of the participating preference shares, and 18s. on each of the ordinary shares. The capital will then be reinstated to £1,275,000 all in ordinary shares of 2s. each, and it is proposed to issue £284,841 of 8 per cent. cumulative income debentures. The debenture holders are asked to accept new stock and ordinary shares in exchange for their holdings.

Great Northern Telegraph Co., Ltd.—The directors propose to distribute a total dividend and bonus of 20 per cent., including the 5 per cent. already paid, for the year 1925, and to transfer £19,444 to the reserve and renewal fund, and £37,500 to the pension fund. It is also proposed to carry forward £244,438. The annual meeting will be held at Copenhagen on May 28th.

Indo-European Telegraph Co., Ltd.—The directors recommend a final dividend of £1 2s. 6d. per share and a bonus of 15s. per share, both free of tax, making a total distribution of 10 per cent., tax free, for 1925. The dividend for 1924 was the same but the bonus was only 7s. 6d. The annual meeting is to be held on April 29th.

Northern General Transport Co., Ltd.—The report for the past year shows a net revenue of £101,630. After meeting loan and debenture interest, &c., and adding £8,305 brought forward, a sum of £53,664 remains. It is proposed to pay a dividend of 10 per cent. (2½ per cent. already paid), to place £3,000 to reserve and £2,053 to debenture sinking fund, leaving £7,111 to be carried forward. The meeting was to be held yesterday (Thursday), when a resolution was to be submitted empowering the directors to increase the capital to £700,000 by the creation of 50,000 six per cent. preference and 150,000 ordinary shares of £1 each. The directors have decided to offer 118,750 ordinary shares at par to present holders in the ratio of one to four.

Wycombe (Borough) Electric Light and Power Co., Ltd.—The balance available from 1925, after meeting debenture interest, preference dividends, &c., and adding the amount brought forward, was £11,782. An interim dividend of 4 per cent., free of tax, on the ordinary shares absorbed £2,500, and at the annual meeting on April 13th it was decided to allocate the balance as follows:—Final dividend of 6 per cent., free of tax; £4,000 to general reserve; £500 to superannuation account; leaving £1,032 to be carried forward. The directors issued £25,000 in ordinary shares during the year and additional plant and cables have been ordered to meet the growing demand.

Simms Motor Units (1920), Ltd.—In his speech at the annual meeting on April 14th, the chairman (Mr. F. R. Simms) said that the trading results for the past year had been very satisfactory, enabling the directors again to declare a dividend of 10 per cent., and to increase the carry forward from £19,742 to £33,171. A branch had been opened in New Zealand and two British branches and one in Canada would be opened during the current year. The directors intended to extend their branch policy over India and the British Dominions, so as to be able to give "Simms Electric Empire Service," coupled with a proved sales policy.

Carmarthen Electric Supply Co., Ltd.—The accounts for 1925 showed a profit of £2,571 and to this was added £584 brought forward, making £3,155. The interim dividends absorbed £410 (including one at the rate of 7½ per cent. on the ordinary), £600 is transferred to depreciation fund, and £500 to capital reserve account. The final dividend on the ordinary shares is at the rate of 3¾ per cent. for the half-year and a bonus of 2½ per cent. is also paid. A balance of £902 is carried forward. Prices to consumers have been reduced.

Kalgoorlie Electric Power Corporation, Ltd.—The Perth (W.A.) correspondent of the *Financial Times* reports that the Western Australian Government has offered to render financial assistance to the company to enable it to extend its plant. It is anticipated that this would result in a reduction of ore-treatment costs and would prolong the lives of the mines by enabling low-grade ore to be worked profitably.

Stock Exchange Notice.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Calcutta Electric Supply Corporation, Ltd.—150,000 new 5 per cent. cumulative preference shares of £1 each, fully paid, Nos. 2,375,001 to 2,525,000 150,000 new ordinary shares of £1 each, issued at £1 1s. per share, partly paid and fully paid, Nos. 1,216,711 to 1,366,710.

Montevideo Telephone Co., Ltd.—An interim dividend at the rate of 6 per cent. per annum has been declared on the ordinary shares in respect of the year ending July 31st. Last year's interim dividend was at the rate of 4 per cent.

Joseph Lucas, Ltd.—Interim dividends of 5 per cent. on the ordinary shares (against 2½ per cent.) and of 2½ per cent. on the 1926 ordinary have been declared in respect of the year ending August 31st.

English Electric Co., Ltd.—The annual meeting was held on Wednesday last. A report of the proceedings will appear in our next issue.

Stocks and Shares.

MONDAY EVENING.

ACCORDING to the various phases of the coal situation, so do Stock Exchange markets ebb and flow in the matter of their price-fluctuations. These movements are brought about, as a rule, as much by sentiment as by actual orders, for trade is exceedingly slack, and in no market can it be said that there is anything that approaches liveliness. The fate of the Electricity Supply Bill is expected to be settled one way or the other in the present session of Parliament, but, as a market factor, it is completely over-shadowed by more pressing industrial problems.

The feature of the week, so far as our markets are concerned, is another sharp rise in the issues of the Underground Electric Railways of London, where optimism has again become pronounced over the expectation of a dividend announcement, joined to the anticipation of some form of capital reorganisation—so often canvassed during the past ten years. The £10 shares gained 7/6 at 3¾ and the "A" shares are up to 12/-. The 4½ per cent. bonds have risen to 101. Even the Contingent Certificates have increased their value by about 50 per cent., standing now at the lordly price of 6d. each. Districts strengthened to 51, but no changes occurred in Central Londons or Metropolitans. There is a good deal of speculation afoot in Underground Electrics, mostly of that kind, how-

ever, in which the buyers pay for what they purchase, content to wait upon the future for a profit rather than to look for an immediate gain.

Sir Douglas Hogg, K.C., is in charge of the Electricity Bill in its passage through Committee. The Industrial Group held a meeting last week, in the House of Commons, with the intention of considering the Bill, and of deciding what assistance should be offered to secure its safe conduct through the Committee stage. It was agreed to propose a series of amendments for the purpose of fortifying the Bill, and, although this was unofficial, hints were given that the Government would look favourably upon the group's movements. With regard to the price movements in the market, the tendency is dull, owing to the coal outlook. Bournemouths have gone back to 58/3 and Chelseas have come on offer, shares changing hands down to 38/6. A fall of 5/- in Kensingtons lowered the price to 13½, Westminsters fell 1/9 to 42/-, Metropolitans to 35/9. Midland Counties remain heavy, upon the apprehensions of shareholders who are timid in regard to the effect which the Government Bill may have upon companies such as this.

The only improvement in this week's list is secured by Urban Ordinary, the price of which has risen to 20/6. City Lights are unchanged at 44/6. Protests are again being made by the City Corporation against the price of electricity, and a speaker at one of the meetings the other day maintained that prices are still much too high, and that citizens must not rest content until the rates approximate more nearly to those paid by neighbouring boroughs. The chairman at the Bournemouth and Poole meeting declared that his company is willing to become a centre of supply, or to obtain cheaper bulk supply elsewhere.

Amongst the cable stocks and shares, Indo-European have risen 2 to 47½, on declaration of a final dividend of £1 2s. 6d. and a bonus of 15s., both free of tax, making 10 per cent. tax-free for the year. This is an increase of 1½ per cent., and the market is very well satisfied. On the other hand, Great Northerns are £2 down at 30, there having been a little selling from Copenhagen. The Montevideo Telephone Company has declared an interim dividend at the rate of 6 per cent. on the ordinary shares, as against 4 per cent. this time last year. The price is better at 23/9. It may be recalled that the final dividend paid last November was 5 per cent., and it is assumed that the final for the current twelve months will show an increase upon this rate. Chili Telephones are ¼ up at 6¾ and Orientals are firmer at 42/-. The Marconi group is placid. Radios have steadied after their violent slump and recovery. Automatic Telephones keep about 48/9 and Internationals have been changing hands on the basis of 43/9.

Electric Supply Corporations remain at 32/6, and at the meeting last week it was stated that potential cheaper supply will be worth while, even at the cost of shutting down small generating stations. The speaker, Mr. K. A. Scott-Moncrieff, said that he hoped the Electricity Bill would be strengthened in the Committee stage, so that its purpose might be achieved on equitable lines. English Electric shares rallied a trifle to 15/-. The report states that an outstanding feature of the company's business at the present moment is the fact that the unexecuted orders on its books already exceed the whole output for last year. This suggests that the progress in the present financial year will be such as to wipe out the memory of the unfortunate 1925, with its absence of dividend for ordinary shareholders.

Manufacturing shares are dull as a whole. Edisons have gone back to 7/9, General Electrics to 28/3, Electric Constructions to 30/- and Brush to 25/9. The same story has to be repeated in regard to the cable construction shares, where declines have occurred in Callenders, Siemens, Johnson and Phillips and India Rubber. Babcock & Wilcox hold their price at 53/9, the comparatively small return which the shares offer at the present time being taken as no more than an earnest of what the company will be able to achieve when trade settles into more prosperous lines.

British Electric Traction ordinary retains its gain of 5 points, and it is taken for granted that the company will declare an increased dividend. Attention has been drawn to the company's preference, the price of which stands at 107. The stock carries participating rights, and optimism looks for a possible 8 per cent. dividend on this stock in the course of time. The company is managed on cautious and safe lines. As a sound investment of the lock-up type, the stock is reasonably priced at the present quotation. Brazilian Tractions are lower, Canada having come in a seller, and Anglo-Argentines have made no further addition to their improvements of last week. Mexicans are a little better. A few of the Indian Industrials have been disposed to weaken, in consequence of the recent rioting in Calcutta. In Calcutta Electric Supply Shares, however, no particular change has occurred, and the price of the new ordinary is better at 3/3 premium. Lancashire new shares are 23/6.

The rubber share market has been depressed by a further fall in the price of the commodity to 1s. 10½d. per lb. Many of the best-class companies are now declaring dividends that afford, at the current quotations of the shares, about 12½ per cent. on the money. With the price of rubber so dull, it is natural enough that the public should feel indisposed to take any particular hand in the market at a time when industrial conditions do not encourage capital to seek speculative investments. The American buyer controls the situation in regard to the demand for raw rubber. "Dollar" stocks have fallen: Montreal Light and Power at 228 and Shawinigan Water at 184½ both show losses of 5 points.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom. £	Dividend. 1924	Dividend. 1925.	Price Apr. 19 1926.	Rise or fall.	Yield. p.c.
Bournemouth and Poole	1	14	14	58/3	—	4 16 0
Brompton Ordinary	1	10	10	1⅝	—	*6 3 1
Charing Cross Ordinary	1	15	15	45/9	—	6 11 2
do. do. 4½ Pref. ...	1	4½	4½	17/-	—	5 5 11
Chelsea	1	12	12	38/6	—	5 16 3
City of London	1	15	15	44/6	—	6 14 10
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Clyde Valley	1	8	8	27/6	—	5 16 5
County of London	1	15	15	56/-	—	5 7 2
do. do. 6 % Pref.... ...	1	6	6	22/-	—	5 9 1
Edmundson's Ordinary	1	7	7	23/-	—	6 1 9
do. 7% Pref.	1	6	7	23/-	—	6 7 3
Elec. Supply Corporation	1	10	10	32/6	—	6 3 0
Kensington Ordinary	5	15	15	13½	−½	5 11 1
Lancs. Light and Power	1	7½	7½	26/-	—	5 11 1
London Electric	1	10	10	32/-	—	6 5 0
do. do. 6% Pref.	5	6	6	5⅝	—	5 11 7
Metropolitan	1	11	11	35/9	−1/16	6 2 10
do. 4½% Pref.	1	4½	4½	17/-	—	5 5 11
Midland Counties	1	5½	6	19/6	—	6 3 1
Newcastle-on-Tyne Ordinary ...	1	7	7	22/-	—	6 7 3
do. 5% Pref. ...	1	5	5	18/-	—	5 11 1
do. 7% Pref. ...	1	7	7	24/6	—	5 12 0
Notting Hill 6% Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6% Pref.... ...	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	17½	18⅝	—	5 18 10
South London...	1	15	15	2½	—	6 0 0
South Metropolitan Pref.	1	7	7	25/6	—	5 9 10
Urban Ordinary	1	4	4	20/6	+1/-	3 18 1
do. 6% Pref.	1	6	6	1	—	6 0 0
Westminster Ordinary	1	15	15	42/-	−1/9	7 2 10
Whitehall Elec. Invst. 7½% Pref....	1	7½	7½	20/-	—	7 10 0
Yorkshire Elec.	1	8	8	26/6	—	6 0 9

Home Rails.

Central London Ord. Assented ...	Stock	4	4	68	—	5 17
Metropolitan	,,	5	5	66	—	7 11 6
do. District	,,	3½	3½	61	+1	6 17 3
Underground Electric Ordinary ...	10	Nil	Nil	3⅜	+⅜	Nil
do. do. "A" ...	1/-	Nil	Nil	12/-	+1/-	Nil
do. do. Income ...	Bonds	6	6	100	—	*6 0 0

Telegraphs and Telephones.

		Dividend. 1923.	Dividend. 1924.			
Anglo-Am. Tel. Pref.	Stock	6	6	102	—	5 17 8
do. Def.	,,	1½	1½	23⅜	—	6 6 4
Automatic Telephone	1	3	6	2⅞	—	4 2 0
Chili Telephone	5	6	5	6¾	+¼	*3 12 9
Cuba Sub. Ord.	10	5	5	6⅜	—	7 8 2
Eastern Extension	10	10	10	17½	—	*5 12 8
Eastern Tel. Ord.	Stock	10	10	175½	—	*5 14 0
Globe Tel. and T. Ord.	10	10	10	17½	—	*5 12 8
do. do. Pref.	10	6	6	10⅜	—	5 11 7
Great Northern Tel.	10	22	22	30	−2	7 6 8
Indo-European	25	8½	10	47½	+2	*5 5 3
Marconi...	1	10	10	1⅞	—	8 8 6
Marconi Marine	1	10	7½	19/9	—	8 0 0
Oriental Telephone Ord.	1	12	12	2⅛	—	*5 16 4
United R. Plate Tel....	5	8	8	7¼	—	*5 1 7
Western Telegraph	10	10	10	17½	—	*5 15 11

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	8	—	9 3 4
do. do. 2nd Pref. ...	5	6	6	22	—	11 8 6
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16 3
British Electric Traction Ord. ...	,,	6	6	127½	—	4 14 0
do. do. 6% Pref. ...	,	6	6	107	—	5 12 2
Brazil Traction	100	4	4	40½	−3	5 9 3
Brit. Columbia Elec. Rly. Pcc. ...	Stock	5	5	85½	+1	5 17 0
do. do. Preferred ...	,,	96/-	96/-	105½	—	*4 9 4
do. do. Deferred ...	,,	129/5	129/5	127	—	*5 2 7
do. do. Deb. ...	,,	4½	4½	75	—	5 13 4
London & Sub. Trac. 5% Pref. ...	1	2½	Nil	5/6	—	Nil
London United Tram. Deb. ...	Stock	4	4	48	—	8 6 8
Mexico Trams, 5% Bonds	—	5	5	64	+1½	7 16 4
Mexican Light Common	100	Nil	Nil	31½	—	Nil
do. Pref.	100	Nil	Nil	66½	—	Nil
do. 1st Bonds	—	5	5	69½	+1	7 3 11
Yorkshire (West Riding)	1	5	—	14/-	—	7 2 10

Manufacturing Companies.

Babcock & Wilcox	1	12	13	53/9	—	*4 16 4
British Aluminium Ord.	1	5	10	2½xd.	—	4 17 0
British Elec. Transformer Pref. ...	1	Nil	7	18/9	−9d.	7 9 4
British Insulated Ord.	1	15	15	3¼xd.	—	4 16 0
Brush Ord.	1	10	10	25/9	−6d.	7 15 4
Callenders	1	15	15	3⅜	−⅛	4 0 0
do. 6½% Pref....	1	6½	6½	22/6	—	5 15 7
Crompton Ord.	1	Nil	Nil	1⅝/-	—	... ...
Edison-Swan	4/-	10	10	7/9	−9d.	5 3 3
do. 5% Deb.	Stock	5	5	83	—	6 0 6
Electric Construction	1	10	10	30/-	−1/8	6 13 4
Enfield Cable, Pref.	1	7½	7½	1⅜	—	6 0 0
English Electric	1	5	5	15/-	+6d.	6 13 4
do. do. Pref.	1	6	6	18/3	−9d.	6 11 6
Gen. Elec. Pref.	1	6½	6½	22/-	—	5 13 1
,, Ord.	1	5	7½	28/9	−1/9	5 6 2
Henley	1	15	16	3⅜	—	4 5 4
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber...	1	5	5	22/-	−6d.	*4 10 11
Johnson & Phillips	1	10	10	2⅞	−⅛	3 9 7
Met.-Vickers Ord.	1	8	8	2 /-	−1/6	6 19 2
do. Pref.	2	8	8	2¾xd.	—	6 14 9
Siemens Ord.	1	—	7½	1⅞	−⅛	4 16 0
Telegraph Construction	12	20	10	28	−½	*3 11 5

*Dividends paid free of Income Tax.

Electricity in Coal Mines.—II.

A Survey of the Present Position in British Mines.

(Abstracts of Papers read before the INSTITUTION OF ELECTRICAL ENGINEERS.)

IT will be recalled that the three papers which were presented to the Institution on April 8th provided members with a general review of the present position of electricity in mines, the application of machinery at the coal face, and the design of storage-battery locomotives for use therein. One of the papers, together with the discussion on all three, was abstracted in our issue of April 16th; the other two are dealt with below:—

The Design of Battery Locomotives.

By L. MILLER, A.M.I.E.E.—*Abstract.*

The average cost of power in a mine works out at 1s. per ton of coal produced; therefore, any slight saving in power which might be achieved by the use of locomotives cannot have very much effect on the cost of the coal at the pit mouth. Any gain in output which may result from the more efficient gathering and conveying of the coal to the surface may, however, have quite a considerable effect on the price.

In considering the use of locomotives to replace rope-haulage systems, there is no doubt a very good case to be made out from the point of view of power-saving and efficient and speedy handling of the loaded trains, provided that the haulage roads are level. If gradients and faults exist, then the locomotive cannot compete with rope haulage from the point of view of speed; in fact, if the gradients are much worse than 1 in 20 the use of a locomotive may be quite impracticable.

For gathering work the locomotive cannot compete with a conveyor system from the point of view of speed. Conveyor systems can be used economically only in thick seams; in thin seams for gathering and marshalling the loaded tubs on the main haulage road and for keeping a supply of empty tubs at the coal face, the battery locomotive can be used to replace the pit pony with satisfactory results from the point of view of speed and cost and also from the purely humanitarian point of view. The locomotive can also be efficiently employed for marshalling purposes at the junction of haulage roads.

After detailing the limitations placed on the design and dimensions of a mine locomotive, it is stated that as its use can only be economically justified on narrow seams, cost is of paramount importance. Standardisation is, of course, the most satisfactory way of keeping down the cost, having got the simplest design, but the chief difficulty affecting standardisation is the gauge question. The B.E.S.A. Report on Colliery Light Rails [C.A. (C.R.) 9,295] shows that out of a total of 468 collieries 132 are using the 2-ft. gauge; there are 56 different gauges in use.

In designing a battery, the largest possible individual cells that can be accommodated in the space available should be used, which will tend to keep the voltage below 80, rather than above it. The two-motor scheme has the advantage that by connecting the armatures and fields in series-parallel it is possible to do away entirely with resistances. On straight runs any advantage due to this will not appear, but in marshalling the tubs and manœuvring, which will have to be done at a restricted speed, the advantage of the two-motor scheme will be apparent; in America the actual power consumption in service has been found to be very much in favour of the two-motor arrangement. The motor short-time rating of 1.64 h.p. per ton per mile per hour is obtained when a coefficient of adhesion of 25 per cent. is employed, plus 1 per cent. for the locomotive friction; the efficiency of the gears is taken at 95 per cent. The 1-hour rating of the motors on locomotives employed for gathering service can usually be taken at roughly half this figure where the grades do not exceed 5 per cent. and are not long.

Many things affect the adhesion factor, and the author recently had some tests carried out on an 18-in. diameter steel wheel which show the effect of several variables on the coefficient of adhesion, but the experiment gives no new information. Attention is called to the effect of increasing the lines of contact from ¼ in. to 1¼ in., which shows a marked improvement in the coefficient. This illustrates the importance, from the point of view of adhesion, of using flat-topped rails. Increasing the diameter of the wheel also tends to increase the coefficient of adhesion. It is quite clear from the tests that the sanding apparatus is of great importance in obtaining good adhesion, and the sanding gear should be so designed that it cannot be put out of action when going through water.

The trend of development in controller design for heavy service is towards the contactor type. It is extremely inadvisable to rely on fuses for over-load protection. The best arrangement is an interlocked circuit breaker which can be replaced only when the controller is in the "off" position. Regarding methods of gearing the motor to the driving axle, in America the tendency is to adopt either spur or worm gearing, and the chain drive is not regarded as sufficiently robust for the service. This is what would be expected for American conditions, where a great many large trolley locomotives are in service on straight haulage work and operating at speeds up to 10 miles per hour at their rated draw-bar pull. For the small powers and low speeds required for gathering service the author believes that a properly designed chain drive will give satisfactory service. It is cheap and easily renewed at low cost, and can be accommodated in a small space without sacrificing the necessary clearance required to avoid the obstructions in the haulage roads.

The saving in power due to the use of roller bearings in the tub and locomotive axle bearings will amount to 40 per cent. of the power required to overcome friction. The use of ball bearings on the motor will result in a reduction in the length between bearings and will assist in obtaining a satisfactory flame-proof design.

The actual saving in power consumption taking into account braking, flange and air friction, grades and curves, will probably amount to as much as 20 per cent., which will enable a smaller battery capacity to be utilised for the same amount of work. The extra capital cost entailed in fitting roller bearings to the tub and locomotive axle bearings should be wiped off very soon. Roller bearings are, however, not likely to be received with any enthusiasm by the colliery personnel.

It has been suggested that where the gate roads are such as to have a heavy grade against the loaded tubs, or where they are of such dimensions as to make it difficult for the locomotive to proceed to the coal face, a winch driven by the propelling motor would be an advantage. This would enable the full rated power of the motors to be utilised without considering the question of adhesion, and the loaded tubs could be hauled up a grade on which the locomotive could not operate. In fact the locomotive would, in addition to its marshalling duties, act as a portable haulage. By arranging a sheave on the roof timbers it could be utilised when erecting or dismantling pumps, coal-cutters, erecting or withdrawing props, &c.

The problem of providing suitable flame protection resolves itself into flange protection, which, without any doubt whatever, is simple and most effective.

No data are available, so far as the author is aware, as to the running costs of locomotives as compared with ponies on gathering service in this country.

A gathering locomotive will cost £400 to £500 per annum to run, and it will be necessary to replace at least three ponies to cover this expense. Where it is possible for the locomotive to replace six pit ponies the case is very strongly in favour of the battery locomotive, from the point of view of running cost and speed of handling the coal.

Machinery at the Coal Face.

By SAM MAVOR, M.I.E.E.—*Abstract.*

The mining industry of this country contains within itself the means of its own regeneration, and if relieved of legislative interference these means would become increasingly operative. It is impossible for anyone familiar with recent practice in mechanical coal-mining and with its economic results, to be otherwise than optimistic as to the future of the industry if the colliery owners and the miners are left to settle their own affairs. The problem of cost reduction is that of increasing individual output, but in mining this problem has special significance because labour accounts for 75 per cent. of the total cost of production, and apart from the number of working hours, the only way to effect substantial increase of output per man and consequent reduction of costs is the systematic application of labour-saving machinery. In other words, there are too many men in the mines; the number must be reduced, for the industry cannot afford to support them. The necessarily gradual nature of the process of adapting mining methods to the use of machinery will to a great extent avoid the imposing of individual hardship by reduction in the number of men employed. At many collieries modern coal-producing machinery is even in these days of low prices earning profits that without it would be non-existent. Unsettlement and the sense of insecurity have seriously retarded progress in the equipment of mines with machinery of production, and have thus accentuated the difficulties of the present situation.

In England the proportion of machine-cut coal to the total output is, according to the latest Report of the Mines Department, 14 per cent., whereas in Scotland the proportion is 47 per cent. The geological conditions in Scotland are not more favourable to machine mining; the difference is due partly to economic pressure compelling a reduction in cost of production, but largely to the permissibility of electricity at the coal face in most of the Scottish mines. In Scotland 23.25 per cent. of the coal-cutters in use are electric and 6.75 per cent. are compressed-air machines. It is not generally realised that a very important factor in the rapid extension of machine mining in the United States is that the comparative freedom from gas in the mines renders electricity permissible, and it is noteworthy that in the most recent years the rate of increase in the proportion of machine-mined coal has been greater in Scotland than in the United States.

The surface equipment of many collieries is splendid, but underground, where the money is lost or made, the coal faces

are crying out for machinery for winning the coal and conveying it from the immediate vicinity of the face—operations to which the whole surface and underground equipment and organisation of the mine are secondary.

Following a general outline of the principal characteristics of the coal seams of this country and of the methods by which they are mined, the development of the mechanical coal-cutter is dealt with, it being pointed out that the design of electric motors for coal-cutters is subject to many limitations. The problem is presented to the electrical designer from a totally different aspect, and the ordinary canons of electric motor design cannot be applied.

There is no recognised standard of power rating of coal-cutter motors, each maker's rating is individual and arbitrary, and, whilst it may serve for comparison of different machines by the same maker, the absence of a uniform basis prevents useful comparison of the rating of machines by different makers. The mean and the maximum powers required by the bar cutter are less than for the chain and disk types; the chain type is next in order, the greatest being required by the disk machine.

Where the mining conditions are favourable and systematic coal-cutting has been established, the machine takes the primary part in a cycle of operations organised to time table for production of 70 to 150 tons per shift, and in which 20 to 50 men (according to the seam conditions) may be engaged. The penalty of failure of the machine to fulfil its part is disorganisation of the whole scheme, suspension of the correlated operations, loss of wages to the men, loss of output and serious increase of costs to the colliery.

With the compressed-air driven coal-cutters the b.h.p.-hours required to be delivered to the compressors is roughly between four and five times that required to be delivered to electric generators for an equal amount of useful work done by coal-cutters. This relatively low efficiency of compressed air is partly inherent in the system as applied to colliery service, and partly due to the conditions under which coal-cutters are used. Wherever considerations of safety do not preclude the use of electricity for coal-cutting, electricity should always be adopted. There are, however, a large number of collieries in this country where there is no alternative to compressed air and its indispensability condones its relative inefficiency. Generally, compressed-air power systems are much less efficient than they might be, because engineers in charge have not yet acquired the habit of measurement that has so importantly contributed to efficiency in electrical engineering. Generally, compressed air is sent underground without being measured, and there is no check upon extravagance in its use or waste.

The b.h.p. rating of coal-cutters is arbitrary; the rated powers of the machines in most general use are between 20 and 50 b.h.p., but all have large overload capacity for short periods, and not infrequently they are required to develop it. Under normal conditions the energy delivered to electric coal-cutters per square yard undercut varies from about 0.2 kWh in the most easily cut materials to about 1.0 kWh in the hardest cuttable materials. The average may be taken as 0.4 to 0.5 kWh; the equivalent in the case of compressed-air machines is much higher, especially in the case of harder materials.

The application of power to the conveying of coal at and in the vicinity of the coal face is technically and economically essential to intensive mining in which the productive effort is concentrated and large outputs are obtained from comparatively small areas. Coal-cutters increase largely the yield of coal per lineal yard of face per day, and, if full advantage is to be realised from the machines, the coal produced must be promptly removed from the faces. The workings of most existing collieries are laid out for hand-mining, and the fact that the difficulties of dealing with the output from coal-cutters, without radical change in methods of loading the coal and delivering it to the mechanical haulage, are practically insuperable is becoming more widely recognised.

The drilling of rock or other strata too hard for cutting by the edge of a rotating drill is a special problem. The material must be attacked by percussive blows and the tool must reciprocate. The difficulties of applying electric power to this service are well known; the compressed-air drill holds the field.

Closely allied to the application of electric power at the coal face is the problem of improved lighting. At most modern collieries the pit bottoms are now not merely lighted by electric lamps—they are illuminated—and illumination pays because it facilitates activity and promotes safety in the operations conducted. There can be no doubt as to the desirability of improved lighting at conveyor faces. Prof. W. M. Thornton has gone far towards making available, in closed-lamp pits, the advantages of coal-face illumination that have been demonstrated where the use of existing equipment is permissible.

It must be accepted that electricity will continue to be excluded from the coal face in many collieries, but the number of these may be reduced by fuller knowledge by mining men of the characteristics of mining electrical appliances and of the conditions essential to securing and maintaining the highest degree of safety in their use, and by fuller knowledge by electrical men of the conditions of service of coal-face machinery and other in-bye electrical apparatus and of the rough nature of the treatment to which it is unavoidably subjected.

Practice of the intensive methods of mining, rendered possible by coal-face machinery, has a bearing on the permissibility of the in-bye use of electricity. The reduced pit room, the less surface of exposed gas-bearing coal, the diminished number, increased area, and improved maintenance of the air ways, and reduction of air leakages between intakes and returns, are all favourable to more effective ventilation, and therefore to safety in the use of electricity. On the other hand, the more rapid advance of the workings may in some gaseous seams liberate so much gas as to exclude electrical appliances at the face. This also applies to seams liable to the occurrence of sudden outbursts of gas, and to places in the working of normal seams where accumulation of gas may be difficult to avoid.

Everyone familiar with underground conditions knows the difficulty of securing adequate maintenance of underground electrical apparatus. It takes time to train the personnel, but experience is educating mining men in the necessity for due attention to this subject, and improvement is progressive. At large collieries with competent electrical staffs, adequate in number, very good standards of maintenance exist; only at such collieries is it wise to send underground delicate automatic devices which are only a snare if their condition and adjustment are not properly maintained.

In the main, the sphere of electricity underground will continue to be in the secondary services—ventilating, pumping, hauling and winding. In application to the primary processes of mining at and near the coal face, the use of electricity is restricted; although increasing confidence in electricity may lead to some relaxation, it is certain that compressed air, displaced by electricity from important services at and near the shaft and in intake airways, will be very much more difficult to dislodge from the region of the coal face.

The services of the mechanical and electrical engineer to the mining industry have been manifold, but abundant opportunity remains and the measure of it is the high cost of coal production. The output per underground worker is too low, therefore too many men are in the industry—that is why wages are low and costs are high. By mechanical and electrical aids to production the output per man can be increased, wages and the status of the miner can be raised, and the cost and price of coal can be reduced.

A Special Electric Furnace.

IN a paper read recently before the Institute of Metals by Mr. Douglas Jepson, M.Sc., a special type of electric resistance furnace, employed in connection with experiments on the influence of gases on copper at high temperatures, is described. It can be evacuated or filled with any desired gas, and contains a crucible which holds the substance under treatment and which can be lowered from the heating zone into a water-cooled chamber, thus giving a very rapid and reproducible rate of cooling. This arrangement was found necessary, for the

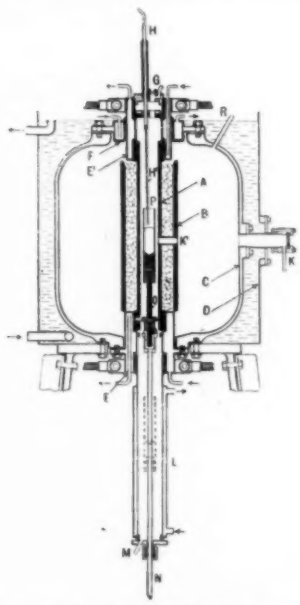


Fig. 1.—An Experimental Electric Furnace.

purposes of the investigations, after a large number of preliminary experiments had been made with a simpler type of furnace.

This furnace, fig. 1, contains a carbon resistor tube A, 520 mm. long, 66 mm. external diameter, and 48 mm. bore; this is fitted into graphite adaptors by means of accurately ground taper joints, the bushes being soldered to the electrodes E and E'. In order to reduce radiation losses, A is surrounded by another carbon tube B, insulated from the lower electrode E on which it stands, the intervening space being filled with wood charcoal. The cast-iron vessel C is entirely surrounded by water contained in the galvanised iron jacket D. The bottom water-cooled electrode E is bolted, with a vacuum-

tight joint, direct into the vessel C, whilst the top electrode E is left free to slide in a water-cooled, insulated collar F, the sliding joint being made vacuum tight with a flexible wax. E, E', and F are made of best quality gun-metal. The top electrode is provided with a cap having two openings, one fitted with a glass window G for general observation, and the other with a sliding sheath H holding a narrow carbon tube H', which can thus be raised or lowered into the furnace. A second observation window is fitted in the side of the furnace at K, a short carbon tube connecting the corresponding apertures in the large tubes. Below the lower electrode is a water-cooled copper cylinder L of similar length to the resistor, the bottom end being closed with a removable cap M, having a special gland through which passes a long steel rod N. The upper end of the steel rod carries a series of radiation screens and an insulated carbon rod O, which in turn supports the graphite crucible P, the inside of which is 125 mm. deep and 25 mm. in diameter. Below the furnace, which is supported 4 ft. above the ground, the steel rod is connected with a long wooden lever by means of which the crucible can be moved steadily and rapidly up or down. To ensure perfectly parallel motion the rod is continued through a bush in the floor.

Evacuation of the furnace is effected by a large rotary oil-pump connected to the cast-iron vessel by a wide-bore tube R. Gas may be admitted at any of the points H, G, K, or M, the first directing the gas into the crucible, and G and K enabling the sight tubes to be kept free from fumes. A mercury manometer is also connected to the top of the furnace. Gases may be allowed to escape either at R or M.

The method of mounting the resistor with taper joints, and the holding of the upper electrode so as to be free to move only in a vertical direction, have resulted in the life of the tube being very greatly increased.

The furnace can be evacuated down to a pressure of 3 mm. of mercury in about 10 min., this vacuum being sufficient for the experimental requirements. The temperature can be raised to 2,000 deg. C. in 15 min. without undue strain. To maintain a temperature of 2,000 deg. C. in hydrogen a current of 1,550 A at 10.75 V is employed. Single-phase energy at 50 cycles is supplied from a separately excited motor generator with pressure-controlling rheostats in the field.

India's Electrical Imports.

(From Our Indian Correspondent.)

THE total value of the electrical imports into India during the calendar year 1925 was Rs.437 lakhs. This is a satisfactory advance on the previous year, during which the total trade amounted to 392 lakhs. Of the total trade, electrical machinery accounted for 210 lakhs, as against 199 lakhs in the previous year, while electrical instruments and apparatus were responsible for 227 lakhs, as against 193 lakhs in 1924. The United Kingdom increased its share from 308 lakhs to 332 lakhs, Germany from 25 to 31 lakhs, and the United States from 29 to 37 lakhs. The principal classes and values were as follows:—

	1924. Rs. lakhs.	1925. Rs. lakhs.
Control and switchgear	37.7	37.8
Generators, alternators and dynamos	33	34.5
Motors	42.6	36.6
Transformers	14.5	13.7
Turbo-generator sets	7.3	15.2
Other sorts	64.3	71.9

Two developments deserve to be noted in the table above. One is the continued decline in the imports of motors, which are now less than half of what they were in 1923. The other is the continued increase in the imports of turbo-generator sets, which more than doubled during the year.

As regards the sources of the electrical machinery, the shares of the different countries were as follows:—

	1924. Rs. lakhs.	1925. Rs. lakhs.
United Kingdom	170.4	174.8
Sweden	1.6	1
Germany	4.9	8.8
United States	13.7	17.3
Other countries	8.8	8

The share of the United Kingdom is steadily increasing. It was 147 lakhs in 1923, 170½ lakhs in 1924 and about 175 lakhs in 1925. Germany during recent years has also been making progress. In 1923 her imports amounted to Rs. 2 lakhs only. They doubled in 1924, and also practically doubled again in 1925. In the case of the United States there appears to be some improvement during the year, but its share has dwindled materially during recent years. In 1923 imports from that country amounted to 43.7 lakhs, but in 1924 they were only 13 lakhs.

As regards electrical instruments and apparatus, the imports of the various kinds of goods were as follows:—

	1924. Rs. lakhs.	1925. Rs. lakhs.
Electrical fans and parts	25.4	28
Electric wires and cables	62.3	81.7
Telegraph and telephone instruments and apparatus	11.9	8.5
Electric glow lamps	12.5	17.9
Electric lamps (other sorts)	3.5	3.8
Parts and accessories of electric lamps	1.2	2.3
Batteries	6.9	8.9
Electric carbons	0.7	0.7
Accumulators	8.6	12.7
Condensers	0.3	0.2
Electric bell apparatus	0.1	0.2
Electric lighting accessories and fittings	13.4	15.7
Meters	6.4	6
Other sorts of electrical instruments	1.5	4.2
Electro-medical apparatus	0.9	1.9
Switchboards	4.7	3.2
Unenumerated	32.5	30.7

The sources of these imports were as follows:—

	1924. Rs. lakhs.	1925. Rs. lakhs.
United Kingdom	138.8	157.6
Germany	20.5	21.8
Netherlands	7.1	8.7
Italy	5.8	6.2
Japan	1.6	3
United States	16.3	20.4
Other countries	3	9

The United Kingdom's share, though it increased during the year, was short by about 5 lakhs of the 1923 figure. Germany, Italy and the Netherlands is showing continued progress. The imports from the United States in 1923 were valued at 18 lakhs.

An analysis of the various types of goods shows that in the case of electric fans and parts the United Kingdom's share increased from 12.4 to 16.3 lakhs, and that of Italy from 5.3 to 5.8 lakhs, but the share of the United States fell from 2.8 to 1.3 lakhs. In the case of the insulated rubber wire, the total imports, of which amounted to 41 lakhs, as against 23.7 lakhs in the previous year, the imports from the United Kingdom increased from 21.8 to 37.8 lakhs, and those from Germany from 1 lakh to 2.1 lakhs. In other insulations, of which the imports were valued at 21.3 lakhs as against 17.6 lakhs, the share of the United Kingdom rose from 16 to 19.4 lakhs. In telegraph and telephone wires and cables, there was a heavy decline in total imports from 6.1 to 1.6 lakhs and the United Kingdom's share consequently declined from 5.9 to 1.4 lakhs. This was due to the growth of the Indian production under the encouragement of the Government of India. The imports of bare (electrolytic) copper wire increased from 14.8 to 17.7 lakhs, and the United Kingdom's share from 14 to 14.8 lakhs. Of the total electric wires and cables, the United Kingdom's share was 73½ lakhs, as against 58 lakhs, in the previous year; Germany's 4.4 lakhs, as against 2 lakhs; and the share of the Netherlands 2.2 lakhs, as against 1.2 lakhs. In telegraph and telephone apparatus the share of the United Kingdom declined from 11.2 to 7.4 lakhs. In electric glow lamps there was close competition between the United Kingdom and the Netherlands, the former's share amounting to 6.5 lakhs and the latter's to 5.9 lakhs. In the face of this competition from the Netherlands, the United Kingdom was able to increase her share from 3.9 to 6.5 lakhs. The share of Germany declined from 1.8 to 1.2 lakhs. In other kinds of electric lamps, the United Kingdom's share was very small, being only Rs. 44,000; the United States was the principal supplier, her share having increased from 1.9 to 2.6 lakhs. In the case of batteries, the United Kingdom's share increased from 3.7 to 4.4 lakhs, and that of the United States from 2 to 2.3 lakhs. In accumulators the United Kingdom's share rose from 6.9 to 9.7 lakhs. In electric lighting accessories and fittings, imports from the United Kingdom practically remained stationary at 8.9 lakhs, while the United States increased her share from 2.5 to 4.6 lakhs, and Germany from 1.5 to 1.8 lakhs. The United Kingdom's share in meters declined from 4.5 to 4.3 lakhs, and in switchboards it declined from 4.6 to 3 lakhs. In the case of unenumerated goods the imports from the United Kingdom fell from 21.6 to 19.3 lakhs, and those from Germany from 5.9 to 4.8 lakhs, but those from the United States increased from 3 to 3.8 lakhs.

Vehicle Operating Cost Tables.—The *Commercial Motor* Tables of Operating Costs of all types of goods and passenger-carrying petrol, steam, and electric commercial vehicles are now in their 18th year of publication. The current tables are based upon the costs prevailing in March, 1926, and the actual experience of owners of each type of vehicle under all sorts of conditions in different parts of the country. The statistics should therefore be a valuable guide to owners of single vehicles and fleets alike. The tables are issued free on application.

New Automatic Telephone Exchanges.

A Private Installation and Four Post Office Exchange Equipments.

The adoption of the automatic telephone system by the British Post Office authorities as the standard for the State service is prompting progressive manufacturers and industrialists to follow suit and equip their premises with the same system for inter-departmental communication purposes.

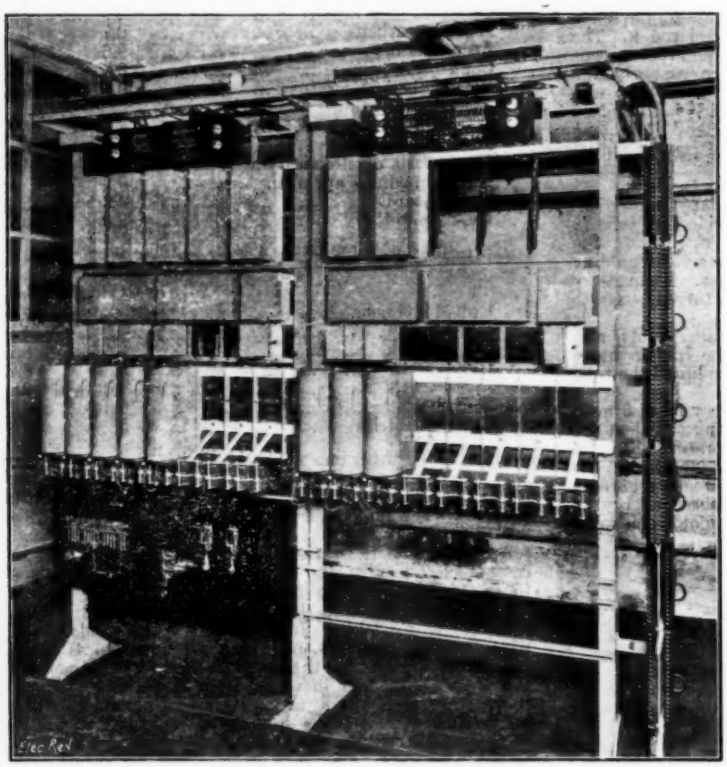


Fig. 1.—A Private Branch Exchange in a Biscuit Factory.

One of the latest concerns to install a Strowger p.a.x. (private automatic exchange) is a well-known firm of biscuit manufacturers, Messrs. W. & R. Jacobs & Co. (Liverpool), Ltd., whose offices, packing rooms, and distributing centre in Liverpool are now served by a 100-line exchange as shown in fig. 1, which was manufactured and installed by the Automatic Telephone Manufacturing Co., Ltd. The immediate capacity of the installation is 67 lines, but provision has been made for an ultimate expansion to the full 100-line capacity, or beyond, should circumstances dictate such growth.

In design, manufacture, and finish, the apparatus is precisely similar to that supplied to the Post Office for public Strowger exchanges. In the functioning of the switches, however, there is a slight difference in principle, it being based on what is known as the "finder" system; each line terminates at the automatic switchboard in a line and cut-off relay, but has no rotary line switch definitely associated with it as in the case of the larger exchanges.

Instead of line switches the rotaries, eight in number, function as "finder switches," their duty being to "find," or select, the particular pair of contacts associated with a calling subscriber's line. Each "finder" controls, or has access to, a corresponding final selector, to which it connects the calling line when it has "found" the calling party's terminals in its own bank of contacts.

Direct current at 50 volts is derived from two Alton storage batteries, each of 25 cells (one being in reserve) and 40 Ah capacity, and provision has been made for charging them alternately through a rheostat from the 230-volt d.c. supply mains. A "Record" controls the charging, an alarm automatically drawing attention to any undue fall in battery voltage.

The present equipment of finder switches and final selectors is eight, enabling a corresponding number of simultaneous conversations to take place. Should the traffic increase, however, there is accommodation for a further eight sets, which would increase the maximum of simultaneous conversations to sixteen, or thirty-two people making use of the system at one and the same time. Refinements include a meter for registering the total number of calls passing through the exchange, and a system of automatic alarm signals indicates any abnormal condition.

The good work of the Post Office Telephone Department in modernising the country's telephone system by periodical additions to, and extensions of, the areas served by the Strowger system continues. The first town to benefit by the change in 1926 is Shrewsbury, the county town of Shropshire, where a 1,000-line automatic exchange was cut into service at the Head Post Office on January 9th.

The equipment, which is of the standard type, comprises nine rotary line-switch units and one p.b.x. unit, which will cater for 1,000 lines, of which approximately 800 are already taken up, but provision has been made for an ultimate expansion to 1,800 lines. The system is four-digit, subscribers' numbers lying 2,000 and 2,999, and the usual special numbers have been allocated.

Associated manual equipment has been provided to enable outer-area subscribers to gain access to Shrewsbury automatic subscribers through the medium of operators who will extend the incoming calls on receipt of verbal instructions in the usual course. The two main batteries (one reserve) are of the Premier Accumulator Co.'s manufacture.

The population of Shrewsbury at the 1921 census was 31,000, so that, even allowing for subsequent growth, the present telephone density of the area (about one telephone to every 40 inhabitants) leaves much to be desired. No doubt the substitution of the automatic system for the slower manual switching of local calls will help to improve this record.

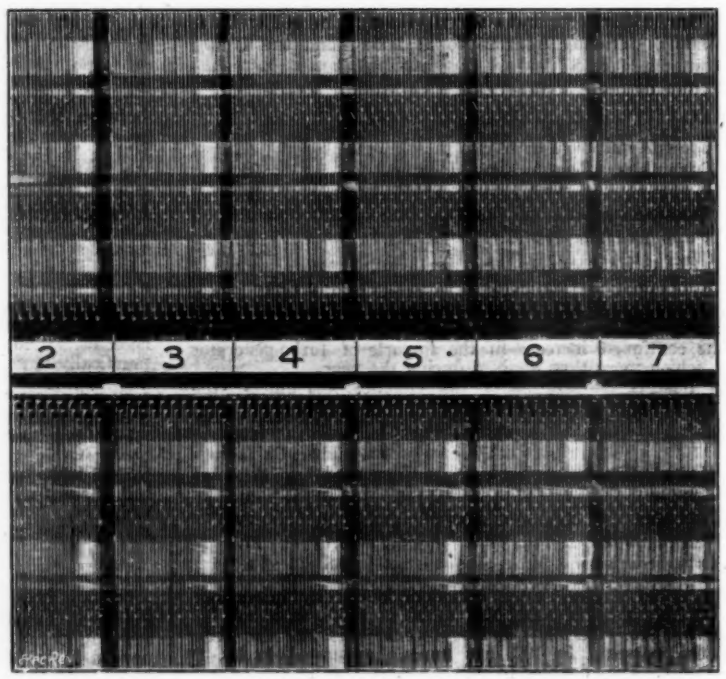


Fig. 2.—Ipswich Exchange: Link Frame Wiring, Selector Trunk Board.

By the completion of two new "satellite" Strowger exchanges at Gosport and Hayling Island, the automatic area of which Portsmouth is the centre has been materially extended. Portsmouth was one of the early towns to enjoy the advantages of a fully automatic service, having been originally equipped in 1916 by the Automatic Telephone Manufacturing Co., Ltd.

Taking post-war growth into account, the present capacity of the main Portsmouth exchange is approximately 5,200 lines. The addition of Gosport and Hayling Island's quota will bring the immediate total of the network up to nearly 6,000 automatic lines, with power to add to that number by virtue of spare equipment available.

Gosport is a Hampshire seaport on the west shore of Portsmouth Harbour, being the site of the Royal Clarence Victualling Yard and Haslar Naval Hospital, and its satelite exchange is equipped for 600 lines, but designed for expansion to 800 lines. The system is four digit, subscribers' numbers lying between 8,000 and 8,599. Switching selector repeaters are employed, their function being threefold: (*a*) To engage trunks for calls to Portsmouth; (*b*) as digit absorbers in the case of local Gosport calls, and (*c*) as repeaters.

Calls to subscribers outside the Portsmouth automatic area are made by dialling "O" when the trunk and junction operator completes the connection on verbal instructions given by the calling subscriber in the usual course; Portsmouth manual operators are retained for this duty. The main batteries are of the Chloride Electric Storage Co.'s manufacture.

Hayling Island, which lies off the coast between Langston and Chichester Harbours, is favoured as a seaside resort and the telephone exchange is a satellite of Portsmouth, the present capacity being 70 subscribers' lines, 70 p.b.x. lines, and three coin-box lines, but there is accommodation for additional lines, or 300 total.

Unlike Gosport, there are no switching selector repeaters at Hayling Island; the group selectors are located in the Portsmouth main exchange, and even local calls proceed via trunks to Portsmouth and back again to the Island. Whilst somewhat extravagant in the matter of inter-connecting trunks, involving two pairs for every local connection, this arrangement effects economies in space at the Island exchange and thus has compensating advantages.

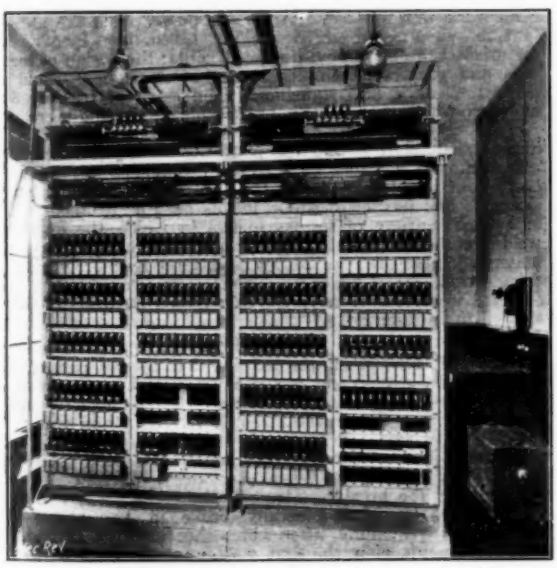


Fig. 3.—Line Switches at Hayling Island Satellite Exchange.

To simplify and centralise maintenance so far as is practicable, certain supervisory features are extended to the Portsmouth exchange. Thus, should the called subscriber fail to replace this receiver at the conclusion of a conversation, the calling subscriber having already cleared in the usual manner, an outgoing repeater will be seized, completing a loop to a first group selector at Portsmouth and a visual lamp signal will be actuated at that exchange, calling attention to the omission. Similarly, the traffic from the Hayling coin-box telephones will be handled directly at Portsmouth.

The population of Gosport, including Alverstoke, at the 1921 census was 33,580, or, allowing for estimated increase, approximately one telephone to every 60 persons. Hayling Island, at the same period, boasted a population of 2,309 souls, or, say, one telephone to every 20 inhabitants, a rather better record than Gosport's, which is probably accounted for by its comparative isolation from Portsmouth.

Both satellite installations were cut into public service on January 13th.

Ipswich, the first town of any magnitude in East Anglia to be converted, is the county town of Suffolk, with a population of 79,371 at the 1921 census. The new A.T.N. (Strowger) equipment has a present capacity for 2,000 lines, of which 1,640 subscribers' and 290 p.b.x. lines are equipped. There are thus 17 regular and 3 p.b.x. rotary line-switch units installed in the switchroom, together with one first group and two second group selector racks and a 2-way repeater rack, with complementary equipment.

The system is 4-digit, subscribers' numbers lying in one of three groups; two groups of numbers have been allocated to p.b.x. lines, and the usual special service numbers have been provided, including one for rural party lines. In addition to a 7-bay rack carrying the usual subscribers' meters, there is a traffic meter rack, a feature of the installation which aptly demonstrates another outstanding advantage of the system. In every telephone area it is the traffic (either estimated or actually determined) which governs such factors as the number of subscribers per operator's position, the number of junctions between two given points, or in the case of A.T.M. (Strowger) equipment, the ratio of group and final selectors to primary rotary line switches, &c. In manual exchanges traffic data are obtained by a "peg count" carried out by the telephonists on duty, and therefore subject to the possibility of error, but the more accurate service of mechanism has been enlisted at Ipswich and elsewhere.

This rack is equipped with four special duty meters, which perform the following functions: The congestion meters automatically indicate the number of times the last choice of a group of trunks is engaged, and thus record the number of lost calls directly due to trunk shortage. Associated with each congestion meter is a traffic unit meter which operates every half minute during the period the congestion meter is energised, thus translating the lost calls into terms of lapsed time. The overflow meter indicates approximately the number of calls rendered ineffective owing to all circuits in a group being engaged, whilst a total traffic record indicates the number of times the switches in any given group are brought into use. To this end a separate meter is provided for each group of switches, and is operated by the release relay belonging to that particular group. Thus this special meter rack ensures the accurate recording of all requisite traffic data, which should prove invaluable to the traffic department. The Post Office is to be congratulated upon the meticulous attention now being devoted to the automatic compilation of guaranteed traffic figures.

At Ipswich batteries of the Premier Accumulator Co.'s manufacture are provided, and the exchange is equipped with complete supervisory and fault-signalling apparatus.

The exchange was cut into service on March 20th last. The telephone density of Ipswich (approximately one to every forty inhabitants) leaves much to be desired. Apart from its local industries, the surrounding country is mainly agricultural and thus lends itself to rural telephone development, and it is anticipated that the introduction of the automatic system will stimulate such development.

Electricity in the Artificial Silk Industry.—A recent "Artificial Silk" number of the *Manchester Guardian Commercial* contains an article by Mr. F. Bunzl Geemen upon the uses of electricity in the artificial silk industry. In the first place the advantages of the electric drive are dealt with, and the author points out that the principal attraction is the elimination of all forms of intermediate gearing, shafting, &c., by the application of the power at the point at which it is required. The design of motors for this class of work is of a very special nature, not only because the electrical and mechanical demands are exceptionally high, but also because all parts have to withstand the attacks of the acids inseparable from the process. This necessitates the choice of special alloys for the various parts of the motor. A further considerable field of utility for electricity in the industry is for the purpose of measurement, regulation, and supervision. There is scarcely another industry in which accurate measurement and supervision of the manufacturing process is of such paramount importance. The possibility of remote measurement is a great advantage. The chemical action of electricity is used in a number of directions, including the recovery of copper from the acid used in the cupro-ammonium process, in "electric bleaching," and in the purification of air charged with sulphurous gases by high-pressure discharges.

Revised B.E.S.A. Publication.—A revised edition of the specification for insulated annealed copper conductors for electric power and light has recently been issued by the British Engineering Standards Association. Few changes were found necessary, although those made are of importance. One extra standard size (0.85 sq. in.) has been added to the list of stranded cables. Tables have been included to cover the thicknesses of vulcanised-bitumen insulated and sheathed cables, and a full list of definitions relating to conductors and cables has also been added. One of the earliest and most effective pieces of standardisation carried out by the electrical industry was in connection with the sizes of electric cables. This work was started in 1899 by the Cable Makers' Association, and at the formation of the Engineering Standards Committee, now the British Engineering Standards Association, a representative committee was appointed to continue this work. The first British standard specification for insulated electric light and power cables was issued in 1904. Copies of the revised Specification, No. 7-1926, may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1, price 1s. 3d. each, post free.

Electric Welded Construction.

Some Applications of Electric Arc Welding.

(Abstract of Paper read before the Institution of Welding Engineers.)

At a recent meeting of members of the above-named Institution in London, a paper with the above title was presented by Mr. James Caldwell, who stated that to anyone considering the use of arc welding the facts of practical importance were that apparatus and materials were now on the market on a commercial basis, that the general technique of the art had been developed to a practical degree, that trained welders were available in many districts and that, with an increased demand, their number could be easily augmented.

Many tests of various natures had been made to establish standards that would give equal, or better, connection between parts than that obtained by riveting and bolting. Apart from a very large number of tests on structural mild-steel carried out by independent parties in this country, facilities had been provided by the Bureau of Standards at Washington, U.S.A., whilst the railway companies in that country, and especially the Belgian State Railways in Europe, had systematically investigated the possibilities of electric welding for constructional service. In Britain the value of electric welding products and machines was assessed by their ability to successfully meet the requirements of the Admiralty and Lloyd's Register of Shipping, whose comprehensive tests were recognised to satisfy the most stringent requirements of modern practice. Tests had shown that when using mild-steel of the usual structural qualities and flux-coated electrodes of various makes, the ultimate or breaking stress was equal to that of the original material; that the weld metal was generally less ductile than the original mild steel and, necessarily, the reduction of area was also less; that welded joints would not stand bending to the same degree as mild steel; and that it could be reckoned that for alternating stresses welded joints had 70 per cent. of the endurance of the unwelded material, and that butt joints were stronger than lap joints, either welded or rivetted. As regarded impact, Lloyd's tests were two blows from a falling weight of 2 cwt. from a height of 9 ft. on to a ¼-in. welded plate, and two blows of 4 cwt. from a height of 12 ft. on to a ¼-inch welded plate to produce no sign of cracking. The performance of these tests disposed of any suspicion that the comparatively low ductility of the weld metal connoted brittleness. Below the elastic limit of the welded material the relation between stress and extension was practically equal to that of the unwelded material, but the most satisfactory and convincing proof of the value of electric-arc welding for constructional services was the success achived in the completion of pioneer undertakings. The durability of such structures was now established (the author stated that he had never known an electrically-welded structure to fail to fulfil the conditions for which it was designed, and the wear and tear of practical use).

After mentioning steam and oil pipe lines, the author said he was not aware of any example of electrically-welded hydraulic pipe line, but the attention which was devoted to the development of water power and the necessity of minimising the capital cost of such works, justified the careful consideration of arc welding as one way of reducing the cost of pipe lines between the reservoirs and power houses. In most cases those pipes had to be laid on mountain slopes over rough ground, and the cost of transport of the pipes and jointing outfit to the site was a heavy one. This element of cost naturally increased with the weight of the individual pieces, and frequently resulted in the choice of a number of small diameter pipes in parallel (although a smaller number of larger pipes would reduce the water friction and the cost of the pipes themselves); by building large pipes *in situ* out of plates cut and curved to shape in the steel works and arc-welded in place, a very great economy was possible. Small petrol-driven sets mounted on trucks could be easily handled and moved as required by the same means of transport as that used for the pipe material, or it might be possible to tap an electric line carried along the route for other purposes.

Transformer cases and tanks were extensively made by electric welding, and the output of one of the large American manufacturers amounted to hundreds per week. As some transformers were mounted on poles and in out-of-door positions, the temperature range due to load was added to by sunshine and weather conditions; in tropical and semi-tropical countries the sunshine heating was often more important than the load heating, and welded tanks endured those conditions quite well. Designs for really large oil tanks (up to 4,000,000 gallons capacity) had been worked out in this country and the U.S.A. Towards the end of 1918 the Admiralty had decided to try welded tanks for this purpose, but the return to peace conditions prevented the completion of the experiment.

A gasholder placed in commission in 1921 at Johannesburg, South Africa, was constructed entirely by means of electric-arc welding; it was of ¼-in. sheet steel, height 25 ft., capacity 8,000 cu. ft. Much larger structures had been successfully undertaken in Australia; the capacity of the welded gasholder at South Melbourne was 3,000,000 cu. ft., diameter 200 ft., and maximum height 105 ft. The crown sheets and all the side sheets of 9/64-in. thickness were arc welded; there was 15 miles of welding, and when the holder was tested there were no more than six leaks. A similar structure at Fitzroy had a capacity of 3,375,000 cu. ft. with a maximum height of 140 ft.; the erection was completed in 16 weeks by 20 men, 8 welders and 12 helpers. "The Fitzroy gasholder was subjected to rigorous examination, and proved to be, if anything, a more effective piece of construction than the South Melbourne holder, and not a sign of a leak was discerned anywhere."

The use of electric welding for the repair of boilers was well established, but the entire construction of boilers by welding instead of by riveting had not yet gone very far; it was, however, practicable. A welded vertical boiler working at 180 lb. pressure was in use at Uxbridge. Messrs. Hawthorn Leslie, of Newcastle, had built a three-furnace Scotch-type marine boiler with most of the joints welded instead of rivetted, the patented design being known as the Hawthorn-Wyber welded boiler; this boiler, designed for a working pressure of 180 lb., was tested to 360 lb. per sq. in., and proved absolutely tight. After being in use at the makers' works for over a year no trouble had been experienced, and it had been approved by Lloyd's Register, the British Corporation, and the Bureau Veritas.

Steel drums and barrels for the transport of oils and other liquids, and wheels for motor vehicles, were included in references to many applications of electric-arc welding, and, finally, numerous cases in which it had been used for general structural work were quoted. Experience proved, said the author, that the adoption of electric welding saved time, labour, and materials, as compared with riveted joints; the design of members and parts was simplified, and stock sections could be utilised to build into stanchions, gantries, roof trusses, &c., in ways which would be impracticable if riveting were employed. Extensive practice had shown that the best conditions resulted from the use of flux-covered electrodes; also the flux covering had an important influence on the composition of the deposited metal. By a proper combination of electrode and flux composition it was possible to make welds of a great variety of ferrous metals in which the deposited weld metal would match in composition and structure the material joined. That could not be ensured by merely making the electrode metal match the work, as their composition was changed in passing through the arc; the co-operation of fluxes seemed to be essential.

Discussion.

Mr. A. E. Plumstead pointed out that in one part of the paper tensile strength of lap joints was said to be from 70 to 85 per cent. of the breaking stress of the plain plate, whilst in another part the tensile strength of lap joints was said to be 100 per cent. Referring to the statement that double-filleted lap joints generally broke across the solid plate on the edge of one of the fillets at a stress of from 70 to 85 per cent. of the breaking stress of the plain plate, and that single-filleted lap joints generally broke in two stages, the closing run first failing, after which the full fillet yielded, he said that in his view the first weld was not so strong as a butt weld, and in the case of the second a construction strain was set up during the welding which caused the lap weld to be weaker than a butt weld; in fact, it was stated in the paper that the breaking stress of a butt weld was equal to that of the original material. The American standard for tanks to withstand a pressure of from 30 to 100 lb. per sq. in. was that the welded joints must be equal to 50 per cent. of the tensile strength of the plate, which equalled 48,000 lb. per sq. in., so that he was unable to reconcile the author's figures with those. He had constructed a good many articles manufactured from ¼-in. plate, and had had difficulty in getting a neat weld; he had found it necessary to tack-weld tanks in some instances, and to run over them in order to secure water-tightness, but rather unsightly lumps were produced on the weld. He had had to repair a gasholder of a capacity of 800,000 cu. ft.; plates and rivet seams were badly corroded, and he had had to weld 120 new plates, varying in size from 4 to 6 ft. square, roughly, over the old plates, whilst the gasholder was actually in use. When the repairs were commenced the operators were rather nervous and there were big leakages to contend with, but the job was a great success.

Mr. E. MacGrath considered that a pressure of 50 lb. was very small to produce leaks in a tank 6 ft. by 3 ft. by 3 ft., made of ¼-in. mild steel plate, even with riveted seams.

Mr. F. E. Saunders, referring to the author's statement that in Britain the value of electric welding products and machines was assessed by their ability successfully to meet the requirements of the Admiralty and Lloyd's Register of Shipping, asked whether that statement referred to plants or to electrodes. If the latter, what protection had the consumer that the same electrodes would be used, and that the electrodes used would be passed by Lloyd's?

Mr. W. J. KEITH asked whether, in the event of pipe lines being welded electrically, electrolytic action might be expected in the course of time. He had been asked that question by a contractor abroad some time ago, but he had been unable to find any information on the subject in welding literature.

Mr. A. C. BROWN asked if the author could give any information as to the magnetic inductance through a welded joint. There was a fairly large field for welding in the making of electrical instruments and small things of that nature, but the problem of magnetic conductivity would have to be taken into account.

The CHAIRMAN (Mr. A. L. Haggerty) suggested that the paper did not go far enough in some directions. It contained a somewhat remarkable list of the applications of electric welding, but it was surprising, even to those who were familiar with the subject, how large was the number of applications which had already been employed. It had to be borne in mind that electric welding was, to a large extent, competing with practices which were already well established, and he suggested that it was not sufficient to show that electric welding could do what had already been done by other processes; it had to be shown that it was better, and also that it was cheaper, particularly the latter. There was a general opinion among engineers, he believed, that electric arc welding was an expensive process, and it was probable that the experimental jobs which had been illustrated were extremely expensive. At the same time, there were probably many who could testify that electric welding when applied to other structures was a very much cheaper process than riveting.

Mr. A. J. HOARE, who replied in the absence of the author, did not attempt to make a full reply to the questions which had been asked, but with regard to lap welds, said he believed that Major Caldwell referred in the paper to the figures which were obtained by Sir Westcott Abell, who, acting on behalf of "Lloyd's Register of Shipping," had carried out tests at Messrs. Cammell, Laird & Co.'s works at Birkenhead in 1918. Personally, he did not think that ¼-in. plate welding could be done so neatly with the electric arc as with acetylene. The main advantage of electrically welding ¼-in. plate was the fact that the sheets could be welded without buckling. As to the machining of the pinion which had been built up by the electrical method, there was no difficulty in machining welded cast steel; difficulty had been encountered in machining welded cast iron, however. He was not aware that the question of electrolytic action on electrically-welded pipe lines had been raised before. The only instance he knew of in which electrolytic action had taken place was in ships' hulls, where the deposited metal stood quite as well as the previous metal did.

As to the utilisation of electric welding for the manufacture of electromagnets, he considered that the conductivity would be sufficiently good, provided the weld was made properly and the metal was absolutely solid, but if the welding were carried out in such a way that there were slag inclusions in the weld, it would reduce the conductivity of the metal.

New Japanese Customs Tariff.

THE revised list of import duties put into force by the Japanese Government on March 29th was issued as a supplement to the *Board of Trade Journal* dated April 15th. It is stated that the primary object of the revision is not to raise additional revenue, although increased returns are anticipated, but to protect a number of native industries. From the new tariff we reproduce below a number of electrical and allied items. Except where otherwise stated the duty is given in yen per 100 kin (132,277 lb.); the abbreviation *a.v.* denotes an *ad valorem* percentage:—

Tariff No.	Description.	Rate of duty.
321.	Insulating tapes of tissues	23.70
419.	Sheet mica	free
419.	Sheet mica, glued together	38.10
464.	Copper wires, not exceeding 0.5 mm. dia. ...	19.30
	Copper wires, exceeding 0.5 mm. dia.	20.40
486.	Insulated electric wires—	
	Submarine teleg. or teleph. cables (armoured)	free
	Other armoured cables combined with india-rubber or gutta-percha	20.00
	Other armoured cables for telephone or telegraphic use	5.50
	Other armoured cables for other purposes ...	11.20
	Flexible cords combined with silk	25 *a.v.*
	Flexible cords, other	18.00
	Unarmoured cables combined with india-rubber or gutta-percha	26.00
	Unarmoured cables, other	25 *a.v.*
515.	Electric stoves, irons and similar utensils ...	35 *a.v.*
528.	(2) Electric clocks (master and subsidiary) ...	35 *a.v.*
543.	Ammeters, voltmeters, and volt-ampere meters	148.00
544.	Wattmeters	20 *a.v.*
	Watt-hour meters	52.30
547.	Accumulators	20 *a.v.*
	Dry batteries	17.30
	Other batteries	25 *a.v.*
	Battery electrodes	20 *a.v.*
	Other parts	25 *a.v.*
569.	Steam boilers, cast-iron	5.00
	Steam boilers, other	8.00
571.	Mechanical stokers	6.10
571.	(2) Fuel economisers	3.35
572.	Feed-water heaters	12.80
577.	Gas engines, weighing not more than 250 kg.	23.10
	Ranging to engines weighing not more than 50,000 kg.	8.2
	Other gas engines	20 *a.v.*
578.	Water turbines and Pelton wheels, weighing not more than 5,000 kg.	20 *a.v.*
	Ditto, weighing not more than 10,000 kg. ...	15.20
	Ditto, other	14.90
579.	Dynamos, electric motors, rotary converters, frequency changers, rotary phase converters and armatures—	
	Weighing not more than 25 kg.	42.40
	Ranging to machines weighing more than 5,000 kg.	15.80
579.	(2) Transformers weighing not more than 25 kg.	26.00
	Ranging to transformers weighing more than 5,000 kg.	7.00
580.	Dynamos combined with motive machinery ...	20 *a.v.*
618.	Filaments for incandescent lamps	20 *a.v.*
619.	Carbon for electrical use, powder or grain ...	8.30
	Carbons, each weighing not more than 300 grammes	20 *a.v.*
	Ditto, weighing more than 300 grammes ...	8.30
631.	Vulcanised fibres (not embossed)	17.80
635.	Incandescent electric lamps	12.80
	Chandeliers, brackets, shades, &c.	40 *a.v.*

The Contractors' Conference at Brighton.

WE have already briefly announced in the ELECTRICAL REVIEW that the First Annual Conference of the E.C.A. Allied Associations (The Electrical Contractors' Association, Incorporated, the N.E.C.T.A., Ltd., and the National Federated Electrical Association) will be held at the Royal Pavilion, Brighton, on Thursday and Friday, June 24th and 25th. We have now received particulars of the full programme of events which has been arranged for these days and for the 23rd and 26th as well. These are as follows:—

Wednesday, June 23rd.

10 a.m.—Meeting of the Council of the Three Associations.
6.10 p.m.—Arrival of Delegates and Registration at the Royal Pavilion.
7.30 p.m.—Reception by the President, Mr. T. E. Alger, A.M.I.E.E., at the Royal Pavilion; music, dancing, light refreshments.

Thursday, June 24th.

10 a.m.—Opening of Conference; address of welcome by His Worship the Lord Mayor of Brighton, Councillor J. Lord Thompson, J.P., and reply by the President.
10.15 a.m.—Presidential address by Mr. T. E. Alger.
11.30 a.m.—Annual General Meeting.
1 p.m.—Luncheon adjournment.
2.30 p.m.—Paper by Mr. Walter Finlay, W.S. secretary of the E.C.A. of Scotland, on "Co-operation Between the Supply and Contracting Sections of the Industry."
3 p.m.—Discussion.
4 p.m.—Paper by Mr. Walter Riggs, A.M.I.E.E., past-president, E.C.A. Allied Associations, on "Apprenticeship."
4.30 p.m.—Discussion.
5.30 p.m.—Conference adjourns.
7.30 p.m.—Smoking concert in the Music Room, Royal Pavilion.

Friday, June 25th.

10 a.m.—Discussion initiated by Mr. Llewellyn B. Atkinson, M.I.E.E., director, Cable-Makers' Association, on "The Need for a Standard Set of Wiring Rules to be Applied Nationally."
11 a.m.—Paper by Mr. F. W. Purse, M.I.E.E., engineer and manager, West Ham Corporation, on "The Registration of Electrical Contractors."
12.30 p.m.—Votes of thanks, and brief address by the President-Elect, Mr. H. J. Miles, M.I.E.E.
1.15 p.m.—Close of business session.
3 p.m.—Garden party in grounds of Royal Pavilion.
9 p.m.—Ball at Royal Pavilion by invitation of His Worship the Mayor of Brighton.

Saturday, June 26th.

Arrangements for golf, drives, &c., have been made for those who desire to spend the week-end in Brighton.

Arrangements under the usual conditions have been made to secure reduced railway rates on vouchers signed by the Conference Secretary. Comprehensive hotel arrangements have also been made, full details of which, together with copies of the Conference programme and other literature may be obtained from the Conference Secretary, Mr. H. J. Galliers, at 32, St. James's Street, Brighton, to whom all general correspondence relating to the Conference should be addressed.

Selected Radio-Telephone Apparatus.

Recent Developments and Improvements.

New "Osram" Valves and Pins.

THE GENERAL ELECTRIC CO., LTD., has recently produced a new 2-V thermionic valve of the dull-emitter type (the "D.E.2"), in two patterns—for high- and low-frequency. Their filament current being 0.12A, these valves mark the half-way point between the dull-emitters proper, consuming 0.06 A, and the semi-dull-emitters, which take from 0.2 to 0.3 A. The potential which the filament will safely withstand is the full two volts, so that when a 2-V accumulator is used a low-resistance rheostat is sufficient. The h.f. type was found to operate satisfactorily as an amplifier (requiring from 40 to 50 V on the anode), and as a detector with a similar plate voltage. The l.f. valve gave satisfactory results as an amplifier, with a 3 to 1 transformer coupling, with between 60 and 70 V on the plate and a grid bias of —3 V. When resistance and choke coupled audio-frequency amplifiers are used the h.f. valve will be found suitable. The amplification factor of the h.f. valve is 12 and the impedance 45,000 ohms. The equivalent figures for the l.f. pattern are 7 and 22,000 ohms. The valve is illustrated in fig. 1.

Valve pins, even the best, have at times proved faulty in consequence of their form. The split type of pin hitherto universally used provides good contact in the early stages of its life, but invariably relaxes in time, and the usual course adopted to remedy this defect is to open the pins with a knife; not only does this weaken them, but in many cases

Fig. 1.—The New "Osram" D.E.2 Valve.

Fig. 2.—Hollow Cross-cut Valve Pins.

recourse to this measure has meant the snapping of one half of the pin. A new type of pin, fig. 2, has been evolved by the GENERAL ELECTRIC CO., LTD., which will shortly be fitted to all "Osram" valves; the above-mentioned D.E.2 types, in fact, are already being supplied fitted with this form of contact, which might best be described as the "hollow cross-cut pin." It consists of a turned brass pin, slightly convex in shape, with a hole bored through it longitudinally; in addition, two fine longitudinal sawcuts, made at right angles, give a spring effect to the pin. The sawcuts do not extend to the tip, and thus impart resiliency without weakening. The lead-out wire from the valve is brought through the centre of the pin and soldered to it at the tip, leaving no flux or other obstruction on the base to reduce insulation between pins; this allows the valve to be pushed right home in the socket, the base lying flush with the panel. The base itself of every "Osram" receiving valve in now composed entirely of a high-grade insulating material which reduces capacity effects between the electrodes and is neat in appearance, the flange for lifting the valve and the ridge for indicating the anode pin being well-known features.

An Unusual Crystal Detector.

The adjustment of a point in contact with a surface, such as a crystal detector, requires mechanism capable of the smallest movement and the contact point should be held firmly and be of a rigid character instead of the usual springy nature. It was with such objects as these that Messrs. S. A. LAMPLUGH, LTD., patented their detector, which is illustrated in fig. 3. The glass dome is held in position and sealed with a rubber ring, and only needs to be pressed in or pulled out. The universal movement enables nearly the whole of the crystal surface to be searched, and it is claimed that as little as 1/100,000th part of an inch movement of the contact is possible. So precise is the simple mechanism that the contact may be withdrawn and again advanced to the identical position at will. In addition to its handsome appearance, the usual facilities for selecting the best spot and ease of access to both crystal and contact will be appreciated.

This detector is mounted on an insulated base and holes are provided at the four corners for fixing the component to a baseboard or panel. At one end two telephone terminals are mounted, and at the other the base is moulded with a projection, and drilled with two holes through which a stiff vertical U-shaped piece of wire passes. The bottom of the U projects into a longitudinal channel cut in the underside of the base, and a cross-piece slide fits over the two vertical legs.

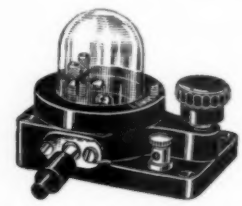


Fig. 3.—The Lamplugh Detector.

Two milled nuts screw on the ends of the legs, and hold the cross-piece in position against two springs, slipped one over each leg. A horizontal split screw in the middle of the cross-piece grips a spear-pointed wire bent vertically downwards to act as a cat's whisker. One end of a plated-metal strip passes between the bend in the U-shaped wire and the underside of the base, while a screw rotated by a knob of insulating material passes through a nut and presses on the other end of the metal strip. This combination acts as a lever with about a six to one ratio, so that an exceedingly fine control of the vertical motion of the cat's whisker is ensured.

The crystal is gripped in a pair of spring tongs moving in a metal sleeve through one side of the base. By pressing a small black knob the jaws of the tongs are opened, and with the aid of the ball-socket mounting it is possible to pick up crystals from the base, and also to obtain coarse adjustment of the contact with the whisker.

A Terminal "De Luxe."

Amongst the little things that count when utility is to be combined with elegance are the insulated terminals made by MESSRS. BELLING & LEE, LTD. As indicated in fig. 4, the screw-action insulated head has a non-rotating engraved top; the stem and cross-hole facilitate connection and shielded metal clamping faces are provided. Below the insulating collar are a standard 2 B.A. stem with a nut and washer, and the transverse slot and clamping nut at the end eliminate soldering. The insulation material used is polished black

Fig. 4.—The "Non-rotating Top" Terminal.

Bakelite, and all metal parts are nickelled. Besides wireless circles, this well-made component should be serviceable to instrument makers and others in the electrical trade. Other patterns of terminal are also made, and also wire couplers and plugs and sockets, which are provided with an internal chuck grip, and present a neat appearance.

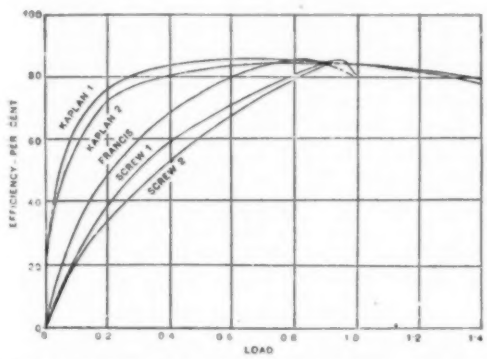
Radio Section at Padua Sample Fair.—The Department of Overseas Trade is informed that a special section for the display of radio-technical instruments is to be organised at the Sample Fair at Padua, which is to be held from June 5th to 20th. Prizes will be offered for the best types of apparatus based on the principles of least cost and highest efficiency. The competition is open to manufacturers of all nations.—*Board of Trade Journal.*

The Kaplan Hydraulic Turbine.

Its Advantages over the Francis and Propeller Types.

In a recent issue of the *Revue Générale de l'Electricité*, Mr. E. Luthy, the chief engineer of the Water Power Department of the Société des Constructions Electriques de France, gives an instructive summary of the tests of various types of turbines for hydro-electric stations carried out by Mr. Elov Englesson, the chief engineer of the Aktiebolag Karlstads Verkstaden, of Kristinehamn, Sweden, and the following notes, based on the summary, may prove of interest.

The Kaplan turbine, while of the screw-propeller type, differs from the usual design in that the blades are capable of having their angle of inclination varied while running, an arrangement which results in several advantages from the operation point of view; but, on the other hand, the blade-adjusting mechanism renders the machine more complicated than an ordinary propeller turbine. It was therefore important to devise a method of blade adjustment control which, while



Kaplan 1, specific speed, 600; Kaplan 2, sp. speed 750. Francis, sp. speed 350. Screw 1, sp. speed 509; Screw 2, sp. speed 600.

Fig. 1.—Variation of Efficiency with Varying Load of Kaplan, Francis, and Propeller (Screw) Turbines, under Constant Head.

maintaining the automaticity of the blade-angle variation, should be as simple as possible. It is to this matter that Englesson has devoted considerable attention, the result of his labours being seen in an arrangement he has patented and which has been applied to an 11,200-h.p. turbine, with a blade diameter of 5.8 metres (19 ft.), built for a water head of 21 ft. 3 in., at the Swedish State power station at Lilla Edet. The problem is solved by the introduction, in the interior of the hub, of a servo-motor on which the real automatic controller acts through the intermediary of a valve. The hub is filled with oil, ensuring the lubrication of all the bearings, an oil-tight ring preventing the escape of any of the oil. In practice it has been found that Kaplan turbines constructed in this way show very little variation in efficiency when running with either low or normal water admissions.

Determining the Maximum Suction Head.

In determining the admissible suction head of turbines, one of the problems to be kept in mind is that when the suction exceeds a certain value, what may be termed "cavitations" are formed, which give rise to a falling-off in efficiency. By cavitation is meant the free space which is established between the surface of the blades and that of the film of water, which instead of following the contour of the blade tends to leave it. These spaces become filled with water vapour and oxygenated air, a mixture which rapidly causes blade corrosion. Cavitations are caused as soon as the vacuum on the blades attains the pressure of water vaporisation.

The maximum suction head depends, therefore, on the conditions of cavitation formation, the essential elements of which are dealt with below.

(1) The height of static suction is equal to the difference between the level of the moving wheel and that of the tail-race. The risk of cavitation increases with the height of suction, it being due to the desire to keep these heights as low as possible that vertical-shaft turbines are preferred.

(2) The axial speed at the delivery end of the moving propeller being designated by c, and that of the outlet of the siphon by c_2, the kinetic height recuperated in the suction pipe is $\eta(c_2^2-c_2^2)/2g$, η being the efficiency of the siphon. The vacuum on the outlet side of the propeller increases in the same degree as the recuperated kinetic height. It follows therefore that the vacuum, and the risk of cavitation, increases with the height, correspondingly to the outlet speed to be recuperated in the siphon. In the propeller type of turbine, the height corresponding to the permitted outlet speed varies between 20 and 30 per cent. of the total available head. It is comprised between the same limits in the case of Kaplan turbines working under normal load, and reaches as much as 70 per cent. of the total head when running at an overload.

Where a high head has to be taken into consideration, the lower values indicated above must be adopted, if the limit of cavitation is not to be exceeded. In this case, the propellers have to be relatively large.

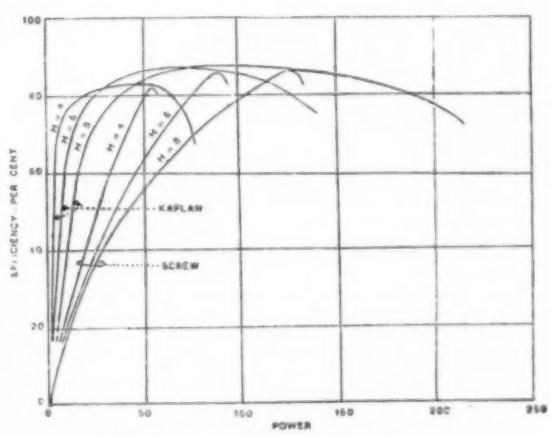
(3) As regards the length of the blades in relation to the pitch, when the turbines are intended to run at a high speed, it is necessary, in order to reduce the friction, to employ small-surface blades, that is to say, blades which are short in proportion to the pitch. This results in an increase in the specific pressure on the blades—an increasing danger of cavitation. It is to avoid these disadvantages that it is necessary for the blades to be made larger, when the height of fall and of suction are themselves greater and to adopt lower values for the specific speed.

In the Kaplan turbines so far tested, the largest blades are slightly longer than the pitch.

As the creation of cavitation also depends on a certain number of other factors, such as the temperature of the water, the profile of the blades, the circumferential speed, &c., it is almost an impossibility exactly to determine the entire conditions which give rise to cavitation. All that can be done is to approximately determine the effect of each of the factors which enter into the problem, and to determine experimentally the permissible suction heights for differing heights of fall and circumferential speeds. To enable this to be done a laboratory has been established at the Karlstad Company's works at Kristinehamn, in which turbines with a propeller diameter up to 250 mm. (9¾ in.) can be tested with any degree of suction height, positive or negative, under water heads ranging from 1 to 11 metres (3 to 36 ft.). The conditions giving rise to cavitation can thus be determined either by brake tests, or, with the turbine in operation, by a stroboscopical method by which the formation of cavitations on the propeller can be directly observed. Plant for similar experiments has also been established by the Czecho-Slovakian firm of Ignaz Storek, and at the Polytechnic School at Munich.

In determining the maximum permissible head of water there is, in addition to questions relative to cavitation, another matter to be taken into consideration—that of the solidity of the rotating propeller. Although, even for fairly large heads, one-piece rotors in propeller-type turbines can frequently be adopted, this is not possible in Kaplan turbines, the blades of which must be pivotally connected to the hub, which therefore in the case of relatively great heads must be of a correspondingly large diameter. So long as the head of water does not exceed 15 metres (50 ft.), the diameter of the hub is not excessive. It is possible without any drawbacks as regards the solidity of the rotor, to employ Kaplan turbines for a water head double that just mentioned, although in such a case the hub assumes rather a large size.

So far Kaplan turbines have only been employed in installations where the head does not exceed 17 metres (56 ft.). The



Speed, 637 r.p.m.; diameter of rotor, 600 mm.

Fig. 2.—Variation of Efficiency with Load of Kaplan and Screw Turbines, for Different Heads.

latter condition obtains at the Wiesenberg power station in Czecho-Slovakia, where there is at work a Storek 300-h.p. horizontal-spindle turbine of the Kaplan type running at 1,000 r.p.m.

The Specific Speed.

In installations where the height of head is low, Kaplan turbines can be run at a higher specific speed than those of the propeller type and still maintain their efficiency, this being rendered possible by a form of non-overlapping blade made in accordance with one of Englesson's main patents. The blades are of course short and as the losses due to friction are re-

duced, the permissible circumferential speed attains a high value.

It is obviously possible to provide propeller-type turbines with non-overlapping blades and to attain equally high specific speeds as with Kaplans. Such a turbine, however, would have a low efficiency at all the varying loads, while that of Kaplans only falls off at maximum load and maximum speed, conditions which are rarely met with, and even when they occur, the question of efficiency is not of great importance. Kaplan turbines have been constructed with specific speeds of over 1,000 r.p.m. for heads of 16½ ft. As the head becomes greater, it is necessary to reduce the specific speed, 600 r.p.m. never being exceeded for a head of 50 ft.

One of the greatest advantages of Kaplan turbines over those of a comparable type such as high-speed propeller and Francis turbines, lies in the slight variation in efficiency under differing

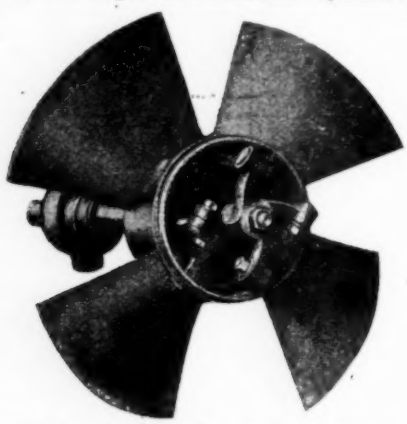


Fig. 3.—Rotor of Kaplan Turbine, with Hub Cover Removed.

loads, this arising from the use of adjustable blades. Fig. 1 is a diagram showing the efficiency curves obtained from tests of two Kaplans, two propeller-type and a Francis turbine at the Karlstad Co.'s laboratory, the diameter of the propellers in all five machines being 600 mm. (23½ in.), the suction pipe elbow through which the horizontal shaft of the turbines extended being also the same in all cases. It will be gathered that the efficiencies of the propeller-type turbines, and more especially of the Kaplans, are closely related to the shape and dimensions of the suction pipe, in which is recuperated, when running at normal load, power which may amount to 30 per cent. of the power of the total head. Englesson admits that the results of the tests at Kristinehamn with propeller-type turbines are not quite so good as those published by several German and Swiss concerns, which, however, conducted their tests with long, straight pipes, but as these are rarely met with in practice they were not employed in the Swedish tests.

Where water under a variable head has to be dealt with, Kaplan turbines, it is claimed, offer a distinct advantage as regards efficiency over propeller-type turbines, owing to the reduction in power development due to lower heads being less. This claim is supported by fig. 2, which shows the comparative curves of efficiency variation under different heads obtained in the course of tests with a Kaplan and a propeller turbine, the propeller diameter of which was approximately 23.6 in. It may be noted that the available minimum delivery corresponds generally to the maximum height of head. In the case of propeller-type turbines, it is therefore necessary that they should be run under conditions which will enable maximum efficiency to be secured and also that the water delivery is sufficient to permit this *régime* to be attained. These difficult problems are not experienced in connection with Kaplan turbines, the efficiency of which varies but slightly under different heads or varying amounts of water delivery, the type possessing under these headings important advantages.

Tests have also been carried out as to economy in water consumption for a given power development which can be effected by the use of Kaplans as against the propeller or Francis types. A summary of the results showing the economy in percentages is given in the subjoined table:—

No. of Sets in parallel.	Economy per cent. over Propeller Turbines.	Economy per cent. over Francis Turbines.
1	38	22
2	29	15
3	20	8
4	13	4
5	7	2

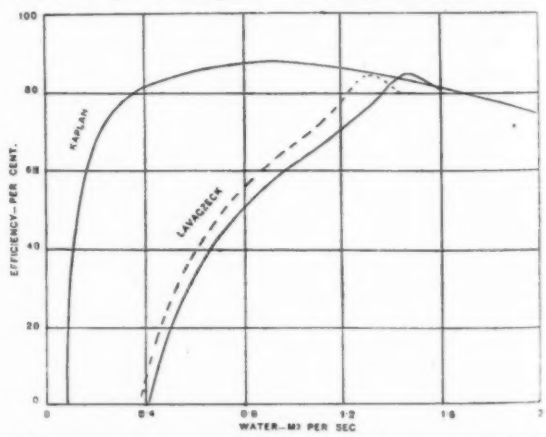
The variations indicated by the table are mainly due to the fact that an electric power station is rarely run at full load, that is at a load corresponding to maximum efficiency as regards the major number of machines. In view of the fact that a much higher specific speed is possible with Kaplans than with the propeller type and more than double that attainable by Francis turbines, it is possible to effect a reduction in the cost of alternators for any particular hydro-electric plant. Moreover, despite the high specific speed, the efficiency within very wide load variation limits is quite satisfactory, so that it is possible to reduce the number of generating sets necessary to give a certain output and so effect an economy in both the first cost and the cost of running an installation.

Another great advantage of the Kaplan turbine is that it may be run at a 50 per cent. overload without any serious diminution in efficiency. This advantage is particularly useful in case of breakdown or temporary stoppage of one of the generating sets in a power station as the remaining sets can be run temporarily at a higher load without any inconvenience or danger. Indeed, it is possible in this way to render the need for a reserve generating set unnecessary.

As it is admitted that Kaplan turbines, being fitted with adjustable blades, are more complicated than propeller turbines, it may be held that this is an undesirable factor in that it may give rise to unreliable station running. It is claimed, however, that the methods of blade angle variation that are now adopted, and the results obtained in actual practice, are such that Kaplan turbines are, from the reliability point of view, comparable with those of the fixed blade type, all reaction stresses due to the blade angle variation being taken up in the blade boss itself, so that the turbine shaft and pivot are unaffected.

As regards the question of cost, Kaplan turbines, in view of the advantages they offer, are of course more expensive to build than either the propeller or Francis types. The difference in cost between the Kaplan and the other types, however, falls proportionately as the size of the turbines is increased. Thus, whereas to develop equal power a Kaplan with a movable-blade propeller diameter of 1 metre (3¼ ft.) is 50 per cent. more costly than one of the other types, the difference falls to 15 per cent. in the case of a Kaplan with a propeller diameter of 6 metres (20 ft.). If only equal propeller diameter is taken into consideration, the difference in cost is greater, amounting to 75 per cent. for a 1-metre propeller Kaplan and 30 per cent. for one of 6 metres diameter. In considering the merits of Kaplan turbines, however, it is not so much their individual cost that has to be regarded as the relation of such cost to the total expenditure on the power plant. Figures drawn up a few years ago for the Swedish Government by the Svenska Commerskollegiet show that the average value of the cost of turbines was only 0.1 of the total cost of the plant in the case of working heads of 5 and 6 metres (16½ and 20 ft.) and that the turbine cost falls to 0.06 of the total outlay on plants where the available head of water is 10 metres (33 ft.). Thus, in the case of a plant with a head of 6 metres, and accepting that a Kaplan would cost 50 per cent. more than a propeller-type machine, the increase in the total cost of the station would only be 5 per cent., which it is claimed would be more than counterbalanced by the increased power output, which is much more than 5 per cent. above that of the ordinary propeller turbine. Moreover, owing to the higher speed of the Kaplan, a less costly alternator can, as has already been pointed out, be used, so that in the aggregate, a set consisting of a Kaplan turbine and generator need be no more costly than a propeller-type turbo-generating set. Fig. 3 shows a Kaplan propeller with the hub cover removed.

Swedish Export for April gives some particulars of the water-power station at Lilla Edet, belonging to the Swedish Government. The mean head is only about 21 ft., but the quantity of water is considerable, some 35,000 cu. ft. a second. The present installation is planned for about 15,000 cu. ft. Three turbines are installed, all of the vertical type and at mean head of approximately 10,000 h.p. capacity each. Two of them were built by the Finshyttan Works and are of the Lavaczeck



Model runners; Kaplan 950 mm. diam., Lavaczeck 980 mm. (dotted), 1,000 mm. (firm). Water reduced to 1 m. head.

Fig. 4.—Efficiency Curves of Kaplan and Lavaczeck Turbines.

type. The runners are 19 ft. 7½ in. in diameter, and are said to be the largest yet built. The most interesting set, however, is the third turbine, built by Verkstaden in Kristinehamn; this is the largest of its kind yet built. The runner of this turbine weighs 62½ tons as compared with 46 tons in the case of the other runners. The guaranteed output at a head of 6.5 m. and 62½ r.p.m. was 11,200 h.p. In the hub of the runner are automatic devices for setting the runner blades at different angles according to the load. At the guaranteed maximum load the turbine handles 160 tons of water per second, but it has proved capable on overload of using 200 tons per second.

Each of the turbines drives an Asea alternator of about 10,000 h.p. The weight supported by the cross bearing of each generator is 440 tons.

The first trial run was made on December 19th. The head was at that time at minimum height, 5.6 m., for which the works had guaranteed an output of 9,200 h.p. The turbine actually developed 11,560 h.p., or more than the guaranteed maximum at 6.5 m. head; it may be expected to develop upwards of 15,000 h.p. at the normal head of 6.5 metres. Test results with model turbines give an efficiency of 89 per cent. for the Kaplan and 85 per cent. for the other type (see fig. 4), and it is estimated that the actual figure for the big Kaplan turbine will be well over 90 per cent. in actual working. The Kaplan turbine has now been running since January 7th, the power being transmitted to Trollhättan.

Before the present installation only small Kaplan turbines had been at work in Sweden. A 400-h.p. set built by the Kristinehamn Works for the city of Gävle electricity works has been running about four years, and the fact that another turbine of the same type and of 700 h.p. capacity has just been ordered is sufficient evidence that it has fulfilled the expectations of the designers. The engineer reports that at the low water prevailing, which could hardly keep another propeller turbine running with no load, the 400-h.p. Kaplan turbine developed 200 h.p.

Reviews.

The Enlarged Heat Drop Tables, H.p. Gauge Pressures, L.p. Absolute Pressures. London: Edward Arnold and Co. Price 10s. 6d. net.

The tables contained in this book are based on the system of equations formulated by Professor H. L. Callender, M.A., and have been calculated by Herbert Moss, D.Sc., and published for the Turbine Section of the British Electrical and Allied Industries Research Association. The tables are arranged in two sections—conversion tables for initial and final pressures, and temperatures, and adiabatic heat drops in B.th.u. per lb. of steam. The latter is arranged in 36 tables indexed under the final pressures, in inches of mercury vacuum, from 27.0 to 29.5 inclusive. Each table gives the saturation temperature, and the initial superheat values of from 0 deg. (saturated) to 300 deg. for 29 initial gauge pressures ranging from 2,000 to 400 lb. per sq. in. inclusive.

Electric Vehicles. By CHARLES W. MARSHALL, B.Sc. Pp. xii + 96; figs. 43. London: Chapman & Hall, Ltd. Price, 9s. 6d. net.

Electrical engineers and those on the commercial side of electrical exploitation have not up to now given to the subject of accumulator road traction the attention and effort its importance warrants. This attitude of apathy may partially be explained if not excused by the calls made on the active personnel of the industry by the rapid advances which have occurred in every branch of recent years, leaving the tired brain with little or no inclination to study that which can without inconvenience be left for some other occasion. Thus it happens that the majority of electrical men know far less about electric vehicles than would have been expected, since transport technique in all its branches exerts as a rule something akin to fascination even on the technically uninstructed mind.

And now Mr. Marshall comes along and presents a compact little volume on electric vehicles which is a model of condensation and yet which deals with salient principles in a scientific manner, devoid of loose generalisation and calculated to enable anyone within the space of an evening's reading to glean a foundational knowledge of this subject.

The treatment very rightly begins with a discussion of the factors governing traction on common roads, from a study of which it will be apparent how applicable is the electrical method of measurement to vehicle performance generally, a fact which automobile engineers, apart from those engaged in accumulator vehicle work, might profit by and reduce their units of measurement to a rational basis in lieu of their "miles per gallon" basis which expresses so badly because so indefinitely the merits of their products. To illustrate the point, a good electric vehicle running at 12 m.p.h. on a hard road (level) will dissipate 90 watt-hours of battery output per gross ton-mile (g.t.m.). A good petrol lorry under similar conditions will consume petrol at the rate of 60 g.t.m. per gallon, which, assuming 19,000 B.th.u. per lb., or say 136,000 B.th.u. per gallon, would entail 2,265 B.th.u. per g.t.m., which converted into electrical units is equal to 633 Wh. In other words, 543 watt-hours per g.t.m. disappear in engine losses in such a vehicle. Remembering that many cars give a performance of only 20 g.t.m. per gallon of fuel it will be appreciated what an immense scope for improvement in fuel energy conversion and utilisation awaits the engineers who design these machines. Prof. Riedler has examined this problem in detail and recorded many tests in a classically important series of records published in or about 1912 under the title "The Determination of the Merits of Automobiles."

Returning to our subject, Mr. Marshall concludes Chapter I—the most important in the volume in the writer's opinion—with a clear statement on the calculation of minimum battery capacity required for given total weights and mileages at 100 Wh. per g.t.m. The effects of gradients and windage are also concisely discussed.

Chapter II discusses the elementary theory of lead/acid/lead and nickel/alkali/iron accumulators, calling attention to the inevitable and fundamental limitations surrounding the problems of specific output, a study of which is commended to those ignorant optimists who at intervals claim miraculous achievements in this field. In plain fact 10 Wh per lb. of complete battery probably represents the maximum realisable output from any practical accumulator if a reasonable life is to be assured—all claims to the contrary notwithstanding. All the leading types are described and illustrated.

A tabloid history of electric vehicles is given early in Chapter III (which may be supplemented by those interested by reference to Milandre and Bouquet, whose "Voitures Automobiles Electriques—Paris, 1899," gives the story in detail), followed by a general survey of modern types of British-made electric vehicles. Mr. Marshall is very impartial and tempers any criticism he tenders by endorsements of practical efficiency in every case, he having in his technical care a large fleet of electrics, including practically every existing type and make—and some others not now made.

Charging equipment is described in Chapter IV, some detail being gone into as to the pros and cons of various equipment for a.c. and d.c. supplies. Battery charging is discussed at length and insistence rightly emphasised on the value of systematic record keeping on properly established forms in the battery department of an electric vehicle garage. Sample forms are given, such as are in use at Glasgow. Constant potential charging is recommended for lead batteries, which, provided proper control is exercised and that a small resistance be inserted in the circuit to give a little control on a fluctuating line voltage, is undoubtedly the correct manner in which to operate this type of cell. Surely it is time that some maker came along with a battery vehicle equipped to charge directly from a 220-V circuit—it is a practical scheme and would save much trouble in charging equipment besides enabling such a vehicle to take charging current at hundreds of places in many cities to-day.

The section on operating experience is of exceptional interest as it gives details of actual results obtained in running a very mixed fleet of electrics over a period of years. Actual data concerning the life of accumulators are given, from which it is established that three years' life may be expected from a first-class lead battery and from six to eight years with an alkaline accumulator of the Edison type.

Conclusion (III) on page 67 reads as follows and should be broadcast:—"There is practically no limit to the useful life of a well-designed and manufactured electric vehicle. After 100,000 miles running, one vehicle is running quite as well as when it was new. The renewals necessary are quite easily carried out, and the wearing parts are of the simplest description."

And listen to No. (IV)!:—"There is practically no danger of a good electric vehicle breaking down on everyday service."

These are the facts which electrical engineers should help to spread. The electric vehicle is a potential load builder for the power station on a grand scale. Every power station should start by having *at least one electric* instead of those old and shabby Fords we see so often and sadly.

Mr. Marshall's excellent little book concludes with a section on electric vehicle testing on the road and one dealing with running costs—also notes on practice outside this country, which latter, however, does not appear of special novelty or to represent any improvement over our own technique. The illustrations of this compact volume are most exceptionally good.

R. J. MITCHELL.

Light Fixtures and Lighting Effects. By M. LUCKIESH. Pp. xiv + 330; figs. 158. London: McGraw Hill Publishing Co., Ltd. Price, 20s. net.

Mr. Luckiesh's numerous works on illumination, especially its decorative and artistic aspects, are well known in this country. He is an enthusiast for the use of light as a decorative medium and his books are invariably readable.

The present work is no exception. In the preface the author makes a plea for recognition of the great possibilities of present illuminants and lighting appliances, and suggests that decorative considerations are not incompatible with scientific control of light. The first three chapters, "The Potentiality of Light," "The Influence of Nature," and "The Imprints of Usage," are introductory. The next two discuss in turn the physical basis of light and colour and their æsthetic aspects. Such points as the alleged psychological influence of various colours, the mental associations connected with them, and the basis of colour harmonies are treated, and here Mr. Luckiesh gives many useful hints. His table arranging colours in order of preference by males and females, based on statistics, is interesting. Subsequent chapters deal with the relations between light and pigment, and it is shown how, in order to obtain a satisfactory effect, the lighting and decoration schemes must be considered conjointly.

In the next section of the book we have the various Ages (Antiquity, Classical, Middle, Renaissance, &c.), analysed and illustrated. The many sketches of lighting fittings of various periods are well done, and this section of the book is worth reading by anyone who desires to know something of these various periods and gain some acquaintance with characteristic styles.

In the final section of the book Mr. Luckiesh sets about his task of showing how new illuminants may best be grafted on to old decorative schemes—for instance, how far flames may be replaced by electric lamps without the latter becoming obtrusive

—and illustrates the decorative possibilities of modern lighting devices. There is undoubtedly a good field for study in connection with the possibilities of coloured light, flood-lighting, &c. In the future anyone who has both a technical knowledge of lighting and an appreciation of considerations that appeal to the architect should find many opportunities of service. Mr. Luckiesh's book is both stimulating and readable and comes at an opportune moment.

Electrical Engineering for Mining Students. By G. M. HARVEY, M.Sc., B.Eng., A.M.I.E.E. Pp. vii+156; figs. 108. London: Sir Isaac Pitman & Co., Ltd. Price 5s. net.

To present a comprehensive account of elementary d.c. and a.c. technology within the limited compass of 156 pages is no mean task, and although the book before us is not beyond criticism, the author has accomplished this task with a considerable measure of success. The work will be a useful summary of basic theory for the young student of mining electrical engineering and will serve as an introduction to the author's larger and more comprehensive book.

The chapter on d.c. theory is generally good, but the treatment of magnetic quantities is too superficial. The equation $B = 0.4\pi IT/L$, although numerically correct for a magnetic circuit in air, is only so because of an arbitrary value of unity for the permeability. The latter quantity is not explained at this stage, and does not appear till the theory of the dynamo is considered. The chapter on this subject gives a good account of the elementary principles of armature winding, commutator, and methods of field excitation; d.c. motors are also satisfactorily treated.

The chapter on a.c. theory can only be regarded as suitable for supplementing instruction received in the class-room and laboratory, and although the author has done well in the limited space at his disposal, the development of the theory is not as coherent as one would like. As a knowledge of elementary trigonometry is assumed there is no justification for asking the student to take the $\sqrt{2}$ ratio of maximum to virtual value of alternating quantities on trust. The notion of form factor which should have been introduced at this point is brought in casually later in treating the theory of the alternator. A useful chapter on the transformer follows, in which, however, we notice the statement that the regulation of a transformer should have as low a value as possible. The student should rather have been instructed in the reasons for designing power transformers with fairly high reactance. Alternators are dealt with before polyphase circuits, and the author has not therefore been able to utilise the useful rotating field method of dealing with armature reaction. In the chapter on 3-phase circuits great pains have been taken to make this difficult subject clear to the beginner. A good deal of space is devoted to the two-wattmeter method of measuring the power factor of balanced 3-phase circuits. We cannot agree with the author that this method is an accurate one; 3-phase circuits are rarely sufficiently exactly balanced or loads sufficiently steady to give more than approximate results. We do not consider, moreover, that the lengthy algebraic transformation of the formula from the tangent to the cosine form need have been given in a book of this character. A good elementary account of the polyphase induction motor is followed by brief descriptions of the synchronous motor, the rotary converter, and the motor converter. The references to electrical instruments throughout the book are scanty. It is hardly correct to state that the moving iron type of ammeter is almost universally used for commercial a.c. measurements. Useful feature of the chapters on electrical machinery are the careful explanations of the method of obtaining efficiencies and the fully worked out illustrations.

The book will be very acceptable, not only to the class of reader for whom it has been specifically written, but also to elementary students and to electrical artisans desirous of obtaining a knowledge of basic theory. From the point of view of production, the book is a credit to the publishers.

Trade-Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from April 14th :—

Windmill (design only). No. 465,832. Class 6. Electric suction cleaning machines.—H. E. Chamberlain, trading as the Excelsior Electric Cleaner Co., 5, Robert Street, Adelphi, W.C.2.

Ever Ready (lettering and design). No. 466,193. Class 8. Electrical batteries and cells, accumulators, voltmeters, electric flexibles, electric cigar and gas lighters. No. 465,300. Class 11. Lamps ((electrical), coils (electrical), dry batteries and accumulators, all for medical or dental purposes. No. 465,301. Class 13. Electric lamps, lamp and torch cases and holders, switches, fuses, &c., and electrical fittings for motor cars.—Ever Ready Co. (Great Britain), Ltd.

Magnet (lettering and design), No. 444,263, Class 8, and No. 440,350, Class 13. Electric switchboards not containing a magnet.—F. B. Cox, trading as the Magnet Engineering Co., 65, Fleet Street, Birmingham.

Spenserphone, Spensers (Scotland), Ltd. (lettering and design). No. 467,318. Class 8. Instruments and apparatus for use in radio-telephony and telegraphy. —Spensers (Scotland), Ltd., 119, George Street, Edinburgh.

Tec, British Make (lettering and design). No. 467,465. Class 8. Electric batteries and cells, voltmeters, flexibles, cigar and gas lighters. No. 467,466. Class 13. Electric lamps and bulbs, lamp and torch cases and holders, switches, fuses, &c., and automobile fittings.—Efandem Co., tLd., 11, Fitzroy Square, W.1.

The "Have" (lettering and design). No. 461,524. Class 14. Cat whiskers of gold and silver for use in radio-telephony.—The firm trading as the Comton Wireless Manufacturing Co., 26-28, Bartholomew Square, E.C.1.

Ceag (lettering and design). No. 453,218. Class 20. Electric lamp bulbs, glass trays for charging stands, &c., all being goods for use in connection with miners' electric safety lamps.—"Ceag" Miners' Supply Co., Ltd.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1924.

27,889. "Terminal for electrical and wireless apparatus." J. C. N. Eastick. November 21st, 1924. (249,578.)

27,911. "Dynamo-electric machines." F. Creedy. November 21st, 1924 (Cognate application No. 17,781/25.) (249,579.)

28,146. "Electromagnetic relay devices." B. Scherer. November 24th, 1924. (249,583.)

28,231. "Aerials for wireless reception." W. J. Goddard and G. Mellor. November 25th, 1924. (249,585.)

30,714. "Directional wireless systems." B. H. N. H. Hamilton and J. Robinson. December 20th, 1924. ((249,594.)

30,995. "Thermionic valve-supporting devices." British Thomson-Houston Co., Ltd., and J. Hutt. December 24th, 1924. (249,601.)

31,009. "Electric radiator heating systems." F. W. Prentice and R. A. Culbertson. December 24th, 1924. (249,602.)

31,119. "Electro-massage apparatus." J. F. V. Pourbaix. December 29th, 1924. (249,605.)

31,136. "Timepieces for controlling electric circuits." A. Archibold and J. H. Tremble. December 29th, 1924. (249,606.)

31,152. "Electrical conductors." Sir C. A. Parsons, J. Rosen, A. W. Grey, and B. Blair. December 29th, 1924. (249,608.)

31,163. "Electrolytic production of zinc from ores or the like." S. Field, E. F. Petersson, W. E. Harris, and Metals Extraction Corporation, Ltd. December 29th, 1924. (249,609.)

31,226. "Discharge tubes comprising a cathode supported or suspended between its points of attachment." Naamloose Vennootschap Philips Gloeilampenfabrieken. January 15th, 1924. (227,815.)

31,240. "Adjustable sensitive electrical regulating devices." C. E. Foster. December 30th, 1924. (249,612.)

1925.

72. "Resistance measurement." C. E. Perry and Evershed & Vignoles, Ltd. January 1st, 1925. (249,615.)

586. "Connection of conductors to the brushes of electrical machines." Compagnie Lorraine de Charbons, Lampes et Appareillages Electriques. January 8th, 1924. (227,453.)

1,633. "Electromagnetic sound reproducers." Fuller's United Electric Works, Ltd., and A. P. Welch. January 19th, 1925. (249,624.)

2,419. "Wired wireless systems." Electrical Improvements, Ltd., Bullers, Ltd., and L. C. Grant. January 27th, 1925. (249,630.)

3,123. "Co-operating electric switches and electric couplings." Simplex Conduits, Ltd., and H. F. McLoughlin. February 4th, 1925. (249,635.)

3,856. "Automatic telephone switching apparatus." Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.). (G. Deakin and L. J. J. Schreiber). February 11th, 1925. (249,640.)

4,743. "Method of and means for eliminating higher harmonics in the aerial in radio transmission systems." C. Lorenz Akt. Ges. March 11th, 1924. (230,810.)

5,588. "Electric switches." G. Edwards and W. Edwards. February 28th, 1925. (249,655.)

5,826. "Interrupters for electric ignition apparatus." M. L. Magneto Syndicate, Ltd., and E. A. Watson. March 3rd, 1925. (249,657.)

5,845. "Operating circuit connections for a polarised relay." Siemens and Halske Akt. Ges. March 7th, 1924. (230,455.)

6,248. "High-tension or multiple-cell electric batteries." F. Ball. March 7th, 1925. (249,661.)

7,047. "Electric contact devices." Forges et Ateliers de Constructions Electriques de Jeumont. March 17th, 1924. (230,856.)

7,227. "Electrical controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). March 17th, 1925. (249,665.)

7,308. "Inductance coils for the reception of wireless telegraphy and wireless telephony." J. J. McKichan. March 18th, 1925. (Cognate Application 11,348/25.) (249,667.)

7,431. "Electron tube apparatus." Westinghouse Brake and Saxby Signal Co., Ltd. (Union Switch and Signal Co.). March 19th, 1925. (249,669.)

10,358. "Oil-break electric switches and the like." Forges et Ateliers de Constructions Electriques de Jeumont. May 27th, 1924. (234,789.)

10,413. "Variable electric resistances." C. H. A. Williams and U.S Radio Co., Ltd. April 21st, 1925. (249,690.)

10,750. "Telephonic receivers, transmitters, or the like." A. M. Marquer May 8th, 1924. (233,684.)

13,907. "Voltage drive system in induction measuring instruments." International General Electric Co. Inc. May 27th, 1924. (234 820.)

15,788. "Wireless direction-finding apparatus." G. Du B. De Bozas. June 21st, 1924. (235,898.)

16,412 "Thermionic valves." Dubilier Condenser Co. (1925), Ltd. July 18th, 1924. (237,233.)

18,672. "Electrical control systems." Forges et Ateliers de Constructions Electriques de Jeumont. August 2nd, 1924. (237,897.)

18,774. "Welding electrodes." British Thomson-Houston Co., Ltd. July 30th, 1924. (237,902.)

19,152. "Electrical signalling apparatus for attachment to motor and like vehicles." W. S. Thimblethorpe. July 28th, 1925. (249,727.)

19,156. "Method of and apparatus for protecting aerial cables." T. Varney. July 28th, 1925. (249,728.)

19,606. "Electric lighting plant for use on power-driven vehicles and the like." Luma-Werke Akt. Ges. August 6th, 1924. (238,228.)

20,737. "Electric glow-lamps." B. Marchi. August 18th, 1925. (249,737.)

23,430. "Control of dynamo-electric machines." British Thomson-Houston Co., Ltd. September 20th, 1924. (240,183.)

23,606. "Electric lanterns." B. Scherer. April 9th, 1925. (249,752.)

24,378. "Electric heaters for removing paint." O. Peyer. September 30th, 1925. (249,754.)

24,501. "Arrangements for operating electron-tube devices from lighting or power circuits." K. G. Jonasson and E. G. Eriksson. October 2nd, 1924. (240,851.)

25,114. "Thermostatic regulating devices for electric heat-producing apparatus." Aktiebolaget Birka Regulator. November 3rd, 1924. (242,252.)

25,432. "Electric motor speed-regulator systems." Metropolitan-Vickers Electrical Co., Ltd. October 14th, 1924. (241,551.)

25,729. "Device on induction wattmeters and induction meters." Landis and Gyr Soc. Anon. February 27th, 1925. (248,323.)

26,774. "Electric relay switching devices." Metropolitan-Vickers Electrical Co., Ltd. November 15th, 1924. (242,965.)

27,199. "Magneto-electric machines." Magnetos Lucifer Soc. Anon. December 18th, 1924. (244,722.)

27,875. "Rotors for electric machines." Siemens Schuckertwerke Ges. April 14th, 1925. (249,769.)

28,294. "Joining electric conductors." Westinghouse Electric & Manufacturing Co. November 26th, 1924. (243,700.)

30,448. "Dirigible headlights for motor vehicles." I. D. Robertson and R. H. Robertson. December 2nd, 1925. (249,780.)

1926.

5,622-3. "Manufacture of electric lamps with light-diffusing or coloured bulbs." General Electric Co., Ltd. November 14th, 1925. (249,786-7.)